# The INSTITUTE Spokesman

MAY • 1952

OFFICIAL PUBLICATION

NATIONAL LUBRICATING GREASE INST

NLGI

DOW CORNING

# Silicone Notes

## ON LUBRICATION

| | |
|---|---|
| REFERENCE NO. | SL–52 |
| FILE | SILICONE LUBRICANTS |

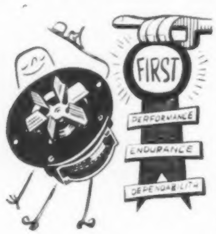
Make sure you have basic data sheets BG-2, 5502, 7101. If misplaced write Department N-17
DOW CORNING CORPORATION
Midland, Michigan

### DOW CORNING 200 FLUID

Dow Corning 200 Fluid has been tested at various temperatures in contact with oxygen under a pressure of 2000 psi. Presence of silicon dioxide was taken as evidence of oxidation. After 1 hour at 300° F. and after one-half hour at 390° F. there was no evidence of oxidation.

In actual practice, that kind of oxidation resistance is illustrated by the experience of the Breese Burners, Inc., of Santa Fe, New Mexico who manufacture the Drafbooster, a forced-air fan for oil-fired furnaces.

Back in 1940, Breese engineers installed a Drafbooster in a heater designed for use in their own offices. All went well the first season, but by the following season it was noted that the petroleum oil lubricating the fan motor's porous bronze bearings had thickened. The fan refused to run at normal speed; insufficient air was provided for complete combustion. By mid-winter, the Drafbooster had to be replaced.




The same thing happened with the next Drafbooster, and the next, and the next. Then, in November of 1945, they installed a unit lubricated with Dow Corning 200 Fluid. This Drafbooster has been in operation 6 years without replacement, relubrication or cleaning.

Breese engineers recently inspected their office unit and reported only negligible bearing wear. The silicone fluid has not thickened and is still crystal-clear. Dow Corning 200 Fluid satisfies their requirements so completely, they say, that if this silicone fluid suddenly became unavailable, they'd stop making Drafboosters.

### DOW CORNING 550 SILICONE OIL

Dow Corning 550 is notable even among silicone fluids for its exceptional heat stability. Stability and oxidation resistance are demonstrated by the fact that it does not gel or decompose to form gums even after heating at 482° F. for 1000 hours in contact with air.

To Flash-O-Graph Corporation, of Long Island City, New York, that kind of oxidation resistance means an annual saving of thousands of dollars in maintenance and repair costs.

The Flash-O-Graph is an animated advertising sign for store windows and counters. The advertiser's message is punched in a black ribbon belt which is driven across the front of a fluorescent lamp by a phonograph-type motor. It is estimated that the belt revolves 31 million times a year.

For appearance's sake, the sign is almost totally enclosed. As a result, considerable heat develops and failure of the motor's sintered-bronze bearings is common. Once, in fact, an entire order of 1000 signs was replaced less than a week after shipment because of bearing failures.

Then, 16 months ago, Flash-O-Graph ran comparative tests between six signs lubricated with the highest grade petroleum oils and six with Dow Corning 550 silicone oil. The best of the petroleum lubricated group lasted only 20 days without relubrication. All six of the silicone lubricated group are still running . . . without relubrication.


About a year ago Flash-O-Graph standardized on Dow Corning 550 silicone oil for the bearings of sign motors. They estimate their service problem has been reduced 99%. Of thousands of silicone lubricated units since put into the field, not one has been returned because of bearing failure.

**DOW CORNING CORPORATION · MIDLAND, MICHIGAN**

DOW CORNING SILICONES

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CANADA: Fiberglas Canada Ltd., 1200 Bay Street, Toronto, Ontario ENGLAND: Midland Silicones Ltd., 49 Park Lane, London, W. 1

*Published monthly by*
The National Lubricating Grease Institute
Harry F. Bennetts, *Editor*
Joanne Couey, *Assistant Editor*
4638 J. C. Nichols Parkway
Kansas City 2, Mo.

1 Year Subscription .......... $2.50
1 Year Subscription (Foreign) .......... $3.25





The INSTITUTE Spokesman

Volume XVI Nnmber 2 May 1952

# IN THIS ISSUE



# ABOUT THE COVER

Storage and precipitation tanks in the stearate manufacturing department of the Mallinckrodt Chemical Works are shown in this month's cover photograph. This specious, modern installation is one of two manufacturing areas in the St. Louis plant devoted exclusively to the preparation of metallic soaps. The large capacity of the equipment illustrated permits uniformity of product and permits sustained, large-scale production. The various operations involved are semi-automatically controlled.

In addition to the major plant in St. Louis, Mallinckrodt also maintains stearate production facilities at Montreal to serve Canadian customers.

# President's page

by George E. Merkle, President, N.L.G.I.

## COPING WITH INFLATION

Inflation is a subject of vital concern to everyone. We all agree, practically without exception, that it is to be avoided if at all possible.

It is generally believed that inflation is the result of long supply of cash and short supply of commodities for sale. This condition need not be serious if the buying public would weigh values and buy conservatively which would discourage runaway pricing.

A more serious cause of inflation is what results from increased production costs which cannot be reduced and consequently must be absorbed out of profits which can ultimately mean failure in some businesses. If demand is high and money is plentiful, there will be no need for absorption of high costs until the public's needs are satisfied.

During the past 20 years there has been a continual rise in production wages. This coupled with no increase in the individual's productiveness and, in fact, the general belief that it has reduced noticeably means that the products manufactured cost more to make each year.

If all these increased costs were passed on to the public, prices naturally would be greatly increased over those two decades ago.

In many industries, and notably the petroleum and grease industries, the consumer is not paying much more today than he did for many years past. In part this is due to increased volume and lower margins of profit but of considerable importance are the savings that have been made possible by technological improvements. These improvements have helped minimize the effect of greatly increased production wages which are not compensated for by increased production on the part of the worker.

If it were not for such technological improvements, as well as other scientific achievements making less expensive substitutes possible, prices would be much higher and inflation worse.

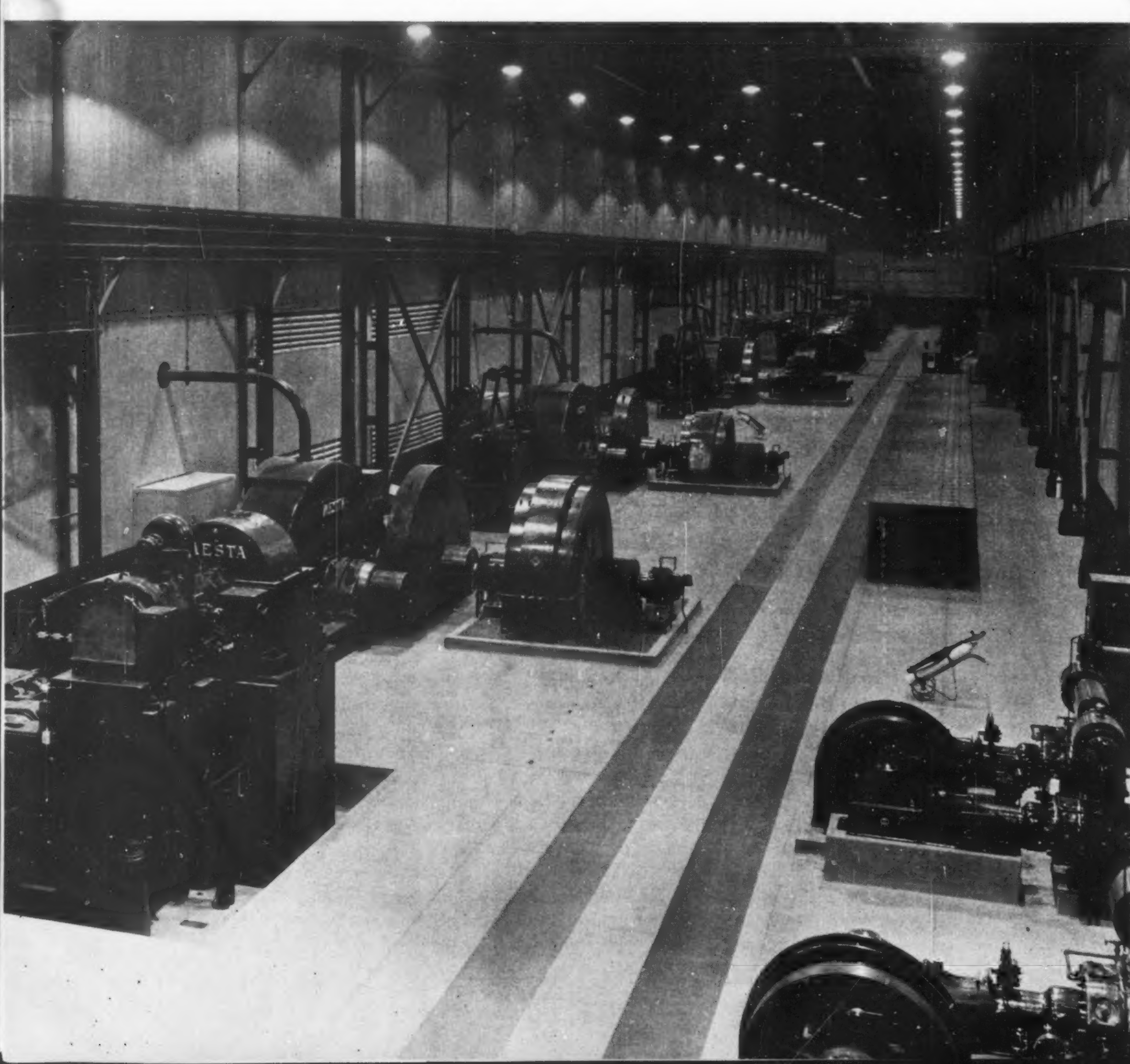
Our real boss is the consuming public. When it balks at the prices we are compelled to accept less or go out of business. Sometimes accepting less may be the forerunner to going out of business.

It is fortunate that industry has been able to keep inflation partially controlled in the face of all efforts to the contrary, otherwise a more pronounced cooling off of business might have resulted.

We are greatly indebted to the technological improvements to date and can count on future advances, but much will depend on what incentive is given those who must take the risks with their time, effort and money.

# A SALES ENGINEER LOOKS

A MODERN MOTOR ROOM in a hot strip mill employs automatic lubrication systems.



# AT THE STEEL INDUSTRY

**Clifford C. Goehring, Esso Standard Oil Company, New York City**

**All photographs are reproduced through the courtesy of United States Steel Corporation. Photographs taken in the 1900s are from the collection of the late Judge Gary.**

THE lubrication of steel mills has been discussed in previous meetings of NLGI, and it is not the writer's intention to restate the principles governing the selection and application of lubricants in this industry. Rather, it is the objective of this paper to portray the practical or business side of steel mill lubrication, particularly as it impresses one whose role is that of service to this industry.

We can probably get the best idea of this impression by imagining what goes on in the mind of an oil company representative assigned to the steel industry for the first time. Many factors will affect this impression: First, there is the general impression of the industry, then the wide differences in age and appearance of equipment, and finally the many practices, policies, and traditions that are peculiar to the steel industry and with which he must become familiar—not only familair, but he must actually absorb them and endeavor to make them his policy, practices and traditions.

First let's imagine the initial confusion he faces on his first visit to a large mill. The immense size of the equipment, with integrated machines filling vast buildings, is staggering. Then, the dust, scale, heat, water and the all-prevailing din taxes the imagination. And, last but not least, there is the terminology used by mill personnel, with such confusing names as universal mill, blooming mill, slabbing mill, billet mill, merchant mill, cross-country mill, etc. We won't even imagine what his first guess as to what a cross-country mill might look like or what it might do.

In time, though, after additional visits, investigations of terminology and discussions with mill personnel, the new representative begins to realize that a gear is still a gear and a bearing is still a bearing, and as usual, both require lubrication. He also realizes that certain fundamental differences do exist between steel mill and other machinery. Disregarding the differences in size, steel mill machinery, in general, operates under higher unit loads, shock loads are more common, and conditions are less favorable to ideal lubrication.

An early impression upon our hypothetical engineer is that lubrication of steel mill equipment is lubrication for high stakes. Here, he will see it is no simple thing to shut down a machine and replace a bearing. In the first place, these are pretty big machines to shut down for anything but the most important of reasons. Then, too, maintenance of a rolling mill is not as readily made as it might be on a textile spinning frame or a machine tool. The machine elements themselves are extremely expensive, and the job of taking one out and putting a new one in is no simple thing. However, neither of these points is anywhere near as serious as the extremely large monetary penalties assigned to unscheduled shutdowns because of irretrievably lost production. Steel mill personnel is especially cognizant of this fact and, consequently, extremely reluctant to make any changes in either lubricants or practices without thorough preliminary study.

Today, this point has a significance that can't be minimized. Our whole national economy and our defense program are geared with steel production. A lubricant that doesn't perform may cause a shutdown. A shutdown means lost production. And today, people in all industries are anxiously watching the steel score board of production.

Another feature of interest to the sales engineer is the differences between equipment performing the same functions

**The older steel mill machinery installed in the early 1900s contrasts sharply with the newer machines in newer mills. There is a big difference in lubrication practices as well as in appearance, productive capacity and operation.**

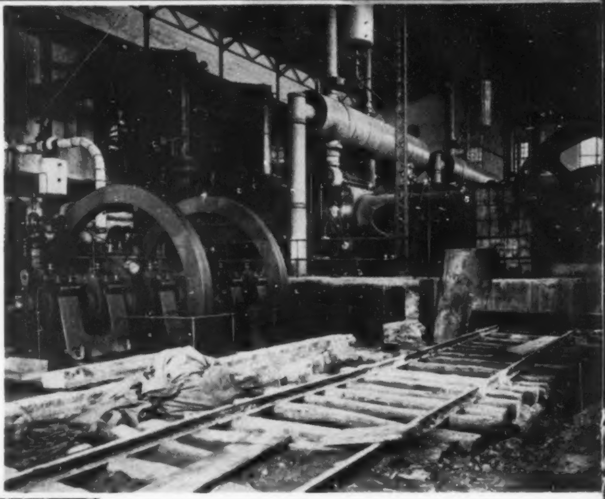


FIGURE 1, an early 1900-model blowing engine supplies air to blast furnaces.

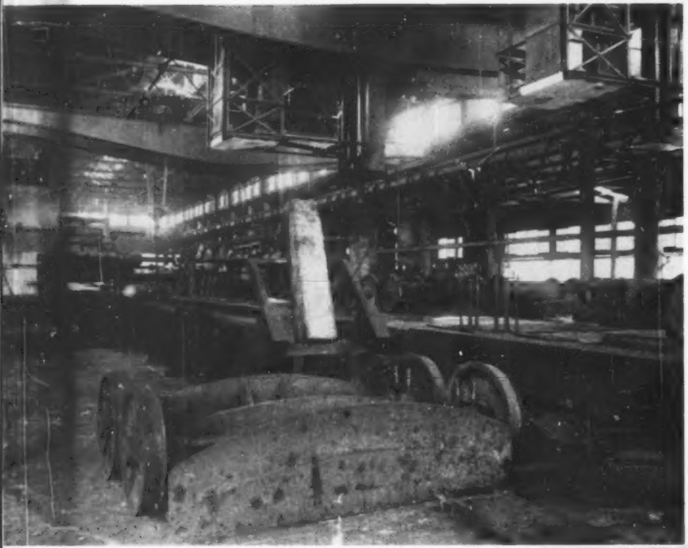


FIGURE 4, gearing drives ingots on the roll tables of a slabbing mill.

FIGURE 5, an ingot buggy deposits an ingot on the approach tables to a mill.

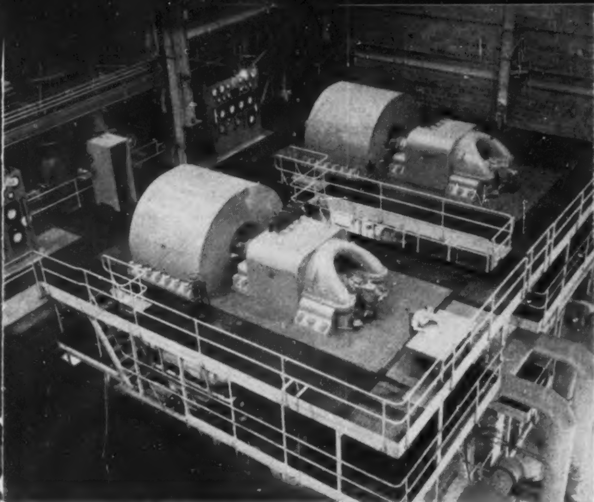


FIGURE 2, two turbo-blowers in the same service is a modern installation. One circulating system using a modern, highly refined lubricant serves all bearings.

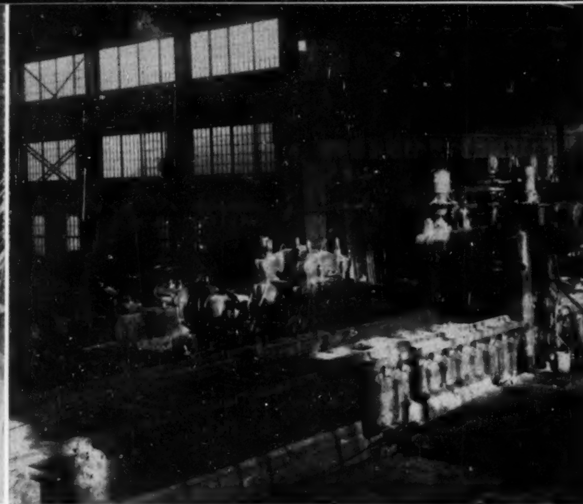


FIGURE 3, open gears above the mill, a steam engine and water lines to cool the roll neck bearings are seen in this photograph of an early 1900 structural mill.

at various locations. This isn't so much a matter of differences in thinking or competitive machine designs. Instead it is largely a function of rapid industrial progress. Almost any piece of steel mill machinery represents a tremendous investment. The steel companies can't afford to discard a machine just because a new one comes along. Instead the older machines continue in production while newer mills use the newer machines. There is a tremendous difference in appearance, productive capacity, operation and, last but not least, lubrication practices between the oldest and the newest mills. Just to illustrate some of the differences, here are some illustrations of old and new equipment. On the whole, the old equipment was that in use forty years ago. Don't be fooled, however, the sales engineer of today can be faced with just as annoying problems on these machines as he can on the more modern ones.

FIGURE 1 shows a blowing engine used to supply air to blast furnaces in the early 1900s. In contrast, FIGURE 2 is a modern installation comprising two turbo-blowers in the same service. In the latter equipment, all bearings are served with one circulating system employing a modern, highly refined lubricant. In the old equipment almost all bearings were lubricated with conventional engine oil which today would not be considered top quality.

The next five pictures are typical mill scenes of the early 1900s.

FIGURE 3 is a photograph of part of a structural mill. Note the open gears above the mill, the steam engine in the background and the water lines to cool the roll neck bearings.

FIGURE 4 exhibits the gearing driving the roll tables of a slabbing mill. Notice that these gears were almost completely


FIGURE 6, crude lubrication practices is illustrated by this old rail straightening machine.

exposed, and were lubricated by pouring or swabbing a heavy residual gear compound which had been heated to a fluid consistency to facilitate application.

FIGURE 5 shows an ingot buggy depositing an ingot on the approach tables to a mill. Note the mill scale, and imagine its effect upon the open gears and the table roll bearings lubricated through open oil holes.

An old rail straightening machine is shown in FIGURE 6. This photograph exemplifies the crude lubrication practices of that era. The bucket was used to catch the oil running from the main bearing. This was, undoubtedly, reused by pouring it back into the unprotected feed along with whatever dust and dirt got into the container.

The next two pictures and the one on page eight illustrate the progress that has been made in the last twenty years or so. These photographs were taken in a modern mill engaged in the manufacture of tin plate and strip.

The first picture, page eight, is a general view of the motor room of a hot strip mill. All incoming air is filtered to remove dust and other abrasive materials. Circulating oil systems serve armature bearings and the reduction gear sets. Centralized pressure lubrication systems for grease serve a variety of grease-lubricated points.

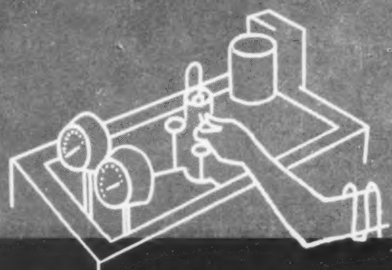
FIGURE 7 is the 4-high universal stand of a continuous hot strip mill. This photograph is typical of modern steel mill machinery, and illustrates effective new design and the employment of modern lubrication facilities. Notice all gearing has been enclosed, with the various cases lubricated either by circulating systems or reservoirs. Anti-friction work and table roll bearings are lubricated by means of centralized pressure lubrication systems, as are all other grease-lubricated points on the mill proper. Backing roll bearings are either of the anti-friction type or of the precision sleeve type; the former lubricated by grease from a pressure system, and the latter by a circulating system containing a high quality mineral oil.

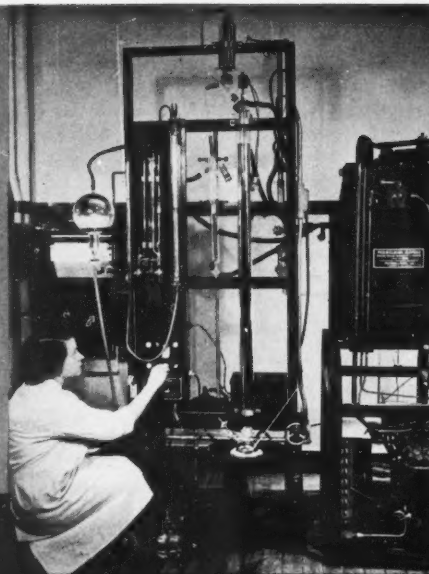
A 5-stand cold reduction mill is shown in FIGURE 8. Although designed somewhat differently, and operating under higher pressures, this unit is similar in lubrication requirements to the hot strip mill just shown.

These improvements in equipment design utilize to full advantage the significant advancements in lubricants and lubrication practices of the same period. As a result, the life of equipment has been extended, damages attributable to the "human element" reduced, wastage of lubricants curtailed and scheduled operation made an actuality. In truth, the steel industry has undergone a "lubrication revolution".

In analyzing these advancements it is obvious that the development and improvement of circulating systems for oil, and centralized pressure lubrication systems for grease have made possible the tremendous advancements. Today's equipment employs these systems to the maximum extent, and the mills continue to modernize older equipment to include these facilities.

Circulating oil systems are employed primarily for the lubrication of gear drives and pinion and screwdown gears





## TABLE

### MAJOR LUBRICANT REQUIREMENTS OF MODERN STEEL MILL MACHINERY

| Lubricant | Service |
|---|---|
| High quality, low viscosity lubricating oil | Steam turbines, turbo-blowers, electric motors and generators, air compressors, hydraulic systems and circulating oil systems for lightly loaded gears and bearings |
| High quality, high viscosity lubricating oil | Circulating oil systems serving precision type journal bearings, and gear drives where E. P. lubricants are not required |
| Mild E. P. gear oils | Lubrication systems for highly loaded gears and bearings |
| E. P. roller bearing grease | Work roll and highly loaded bearings. Also miscellaneous machine and mill elements such as chocks, slides, nuts, etc. |
| General purpose pressure grease | Principally auxiliary equipment where quality requirements are not severe |
| Electric motor and high temperature grease | Electric motors and high temperature lubrication points |

where mild extreme pressure gear oils are used. They are also used to lubricate the precision journal bearings finding extensive use on all rolling mills. In addition, circulating oil systems find application on almost all steel mill auxiliary equipment such as electric motor drives, steam turbines, turbo-blowers, etc.

The sales engineer must be familiar with the oil conditioning equipment used in these large circulating oil systems. These include a variety of filters, screens, centrifuges, settling tanks, etc. In selecting steel mill lubricants thought must be given to the effect of this conditioning equipment upon the lubricant, particularly with the mild extreme pressure gear lubricants containing additives to impart improved film strength.

With regard to centralized pressure lubrication systems, the steel industry has always used lubricating grease in enormous quantities. However, developments in the last 25 years have materially affected the grease picture.

These are the development of the 4-high mill utilizing anti-friction, grease-lubricated, sealed work roll and backing roll bearings, and the perfection of centralized pressure lubrication systems for grease. Prior to these developments, grease lubrication of journal bearings, other than roll neck bearings, was not extensive. However, greases came into their own with these changes because of their desirable features of sealing, resisting the washing action of water, and ability to remain in place. With centralized pressure lubrication systems it has become possible to lubricate many points from one location with automatic equipment in one simple operation. Therefore, the application of grease in the steel industry has been greatly extended, and many bearings formerly lubricated with oil now employ grease.

Although it is still necessary to supply lubricants for old equipment, the transition to new equipment has gone forward sufficiently to require larger quantities of modern lubricants. The table, above, breaks down the various categories required in large quantities for modern equipment. This list does not include process applications such as roll oils, rust preventives, cutting oils and the like.

This table emphasizes the developments of recent years. In almost all these items it is important that the generally recognized quality requirements are met in every respect. Conspicuous by their absence are such time-honored lubricants as steam cylinder oil, engine oil, black oil and block grease.

In this regard, it is now generally recognized that the cost of lubricants is quite different from the cost of lubrication. The former cost is limited to two factors, price per unit and consumption. The latter takes into account the costs of application and maintenance. The realization that a good portion of maintenance cost is actually lubrication cost has resulted in a much clearer understanding of the importance of efficient lubrication.

In recommending lubricants and discussing the selection of lubricants with steel mill personnel, the cost of lubrication is of paramount importance. Mill tests of experimental products are frequently necessary to judge whether or not improved products will be effective in reducing this cost. It is in discussions of this nature that the sales engineer justifies

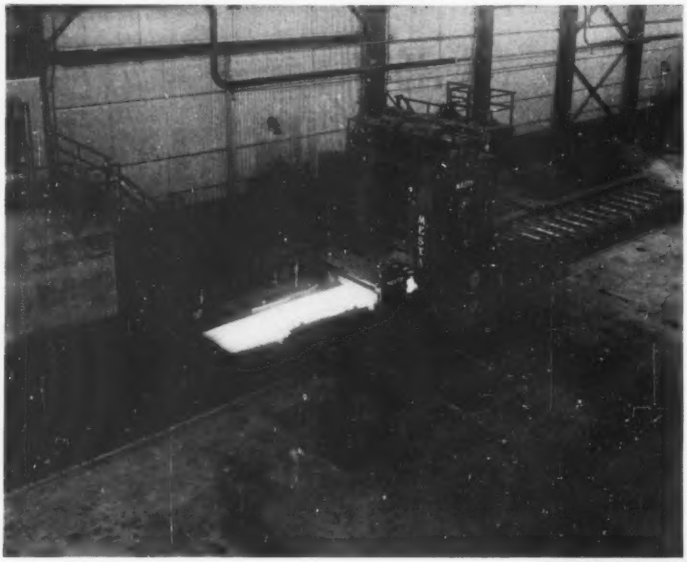


FIGURE 7, typical of modern steel mill machinery is this 4-high universal stand of a continuous hot strip mill.

his expense to his company, as well as provides the service that the steel industry needs.

Our sales engineer must also learn that the steel industry has, to a large extent, developed its own resources to handle lubrication problems. Although the pattern of organization may differ among the major steel producers, the basic set-up is similar.

Generally, each corporation employs a full-time chief lubrication engineer who coordinates all practices, particularly between plants. He also provides assistance on all serious lubrication problems at any one plant. He cooperates with other departments such as purchasing, engineering, maintenance, etc., on such projects as lubricant standardization, justification for new lubrication equipment and evaluation of available lubricants.

At each plant a local lubrication engineer follows the lubrication picture. Generally, this is a staff position, with direct responsibility for lubrication resting with either the maintenance or operating divisions. It is the responsibility of the lubrication engineer to recommend lubricants and practices and follow performance, as well as to investigate lubrication failures and any occurrences which might indicate future difficulties resulting from the use of incorrect lubricants or lubricant practices.

From the standpoint of the lubricant supplier, the lubrication engineer, both in the central office and in the individual plant, does much to simplify steel mill contacts. Previously, it was necessary for a sales engineer to deal with foremen, maintenance superintendents, operating officials, etc., in each department. With a lubrication engineer on the job, it is possible to work with him directly and have him make whatever additional arrangements are necessary.

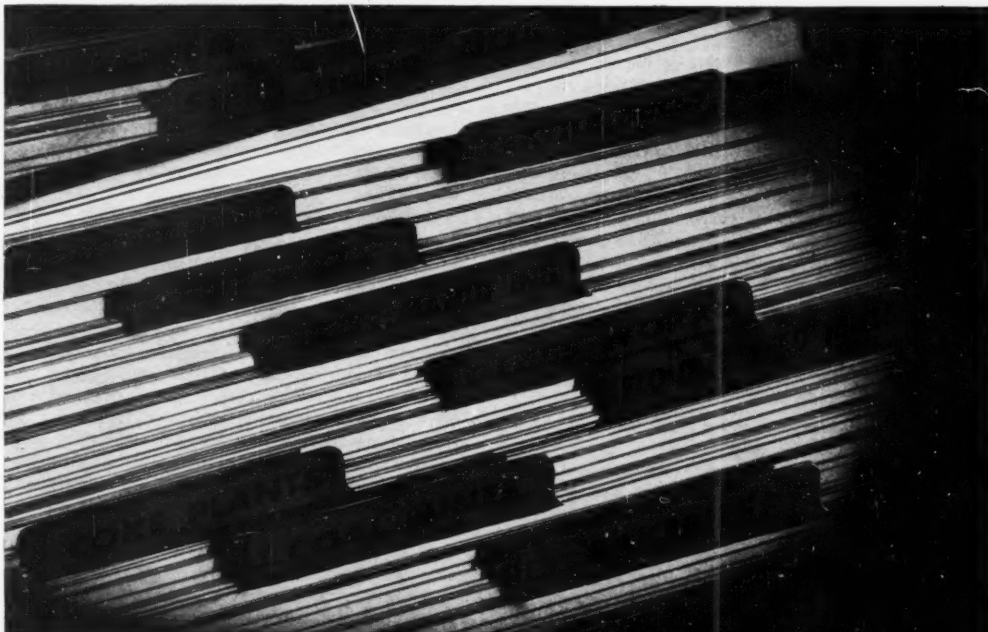
FIGURE 8, this 5-stand cold reduction mill is similar in lubrication requirements to the hot strip mill shown in Figure 7.

The sales engineer will find that the steel mill lubrication engineer is in an excellent position to serve the petroleum industry by obtaining valuable performance data on experimental lubricants. As you know, lubricant development work in petroleum research laboratories generally terminates when the product under consideration has passed physical, chemical and correlative laboratory tests. Beyond this point, field tests are necessary, and the experience and cooperation of customers are indispensable. Field tests under the close super-

vision of competent lubrication engineers are especially valuable, and through the close cooperation of plant and oil company lubrication engineers, significant improvements in new products have been realized. The sales engineer should work closely with the steel mill lubrication engineer if the efforts of his company are to be furthered. That this is feasible is evidenced by the joint progress of the two industries.

The sales engineer must also take into account the preferences of certain plants for given types of products, even though other types have been used more successfully elsewhere. Such preferences are not without foundation in many cases. There have been occasions when the best lubricant by field test at one spot has failed in similar equipment at another location. Only by continued close cooperation between the sales and plant lubrication engineer can progress be made in the solution of problems like these and in the advancement of lubricant technology.

By following our sales engineer through his period of indoctrination into the steel industry, it is hoped that a clearer understanding of his problems has been developed. In truth, a sales engineer in many cases is neither fish nor fowl, occupying a position between two great industries. In dealing with each, he must be guided by his knowledge of the other, and it is only through understanding of both that progress is expedited.



# MAINTENANCE LUBRICATION

## OF BALL AND ROLLER BEARINGS

**R. L. WHEELER**
**Chief Fuels and Lubricants Engineer**
**Gulf Oil Corporation**
**Pittsburgh, Pennsylvania**

### Historical

Some of the fundamentals underlying modern methods of overcoming frictional resistance were apparently recognized long before the advent of the present mechanized era. Although much of the early development work in connection with the substitution of rolling friction for sliding friction is obscured in the mists of antiquity, there is evidence which leads us to believe that as early as 3000 B.C. the principle of rolling friction as typified by the wheel and axle was fairly well understood. A painting from the Egyptian Fifth Dynasty is reported to show a scaling ladder having solid disc wheels running on an axle. The Bible makes reference to the removal of wheels from the chariots of Pharaoh's Army when the Israelites were crossing the Red Sea. Remains of chariot wheels were also found in Tutankhamen's tomb.[1] It is believed that the Egyptians used rollers for transporting huge blocks of stone when building the Pyramids.

Space does not permit following from these early beginnings the historical details of the evolution of present day anti-friction bearings. It is interesting to note, however, that one of the first practical applications for ball bearings was in the bicycle. According to Allan,[2] the first ball bearing bicycle was built in A.D. 1868; and by 1883, the popularity and success of the bicycle had an important influence in establishing the manufacture of ball bearings as an industry. From this point, the expansion of the ball and roller bearing industry both in this country and abroad was quite rapid.

[1]Discovered by Dr. Howard Carter in 1922.
[2]*Roller Bearings*, by R. K. Allan.

### Scope

As the subject implies, this discussion will be confined primarily to the lubrication of the conventional types of ball and roller bearings in the field. It is not intended to cover the lubrication of pre-packed or so-called life time lubricated bearings. Included, however, will be a short discussion on cleaning anti-friction bearings, followed by a brief outline as to the cause and prevention of bearing failures.

### Lubrication — Related to Machine Design

Ball and roller bearings, like all other types of bearings, cannot function without proper lubrication. Yet, despite the importance of lubrication, under usual conditions of temperature and load, the majority of ball and roller bearings will operate with a surprisingly small amount of lubricant. Furthermore, under normal operating conditions, ball and roller bearings rarely fail due to faulty lubrication alone. If lubrication failure does occur, there are generally other factors present which contribute directly to the failure or which render proper lubrication extremely difficult. These statements are made, not to depreciate the importance of proper lubrication, but rather to emphasize the fact that there are many mechanical details surrounding the design, manufacture, and operation of equipment which must be considered in order that satisfactory bearing performance be obtained. To this end, therefore, cooperation is desirable between the bearing manufacturer, the machinery builder, the lubricant supplier, and the ultimate machine user. This is particularly important during the development and design of a new piece of equipment. Cooperative work while the machine is on the drawing board is the best insurance that lubrication receives

the attention which it deserves. At this time, consideration may be given to such details as proper bearing seals, suitable application methods, the design of centralized lubricating systems, and provision may be made if necessary for oil cooling and filtration. Unless these lubrication details are given adequate consideration during the design of the machine, it is often impossible or it may be economically impractical to add these features after the machine is built.

## Functional Requirements of Lubricant

Let us examine for a moment the lubrication requirements of an anti-friction bearing. The lubricant may be called upon to perform four general functions, viz.,

(1) Lubricate the friction elements of the bearing.

(2) Help seal the bearing against entry of foreign matter.

(3) Dissipate frictional and transmitted heat.

(4) Prevent corrosion due to moisture, fumes, or other outside contaminants.

Considering these four general requirements collectively, an attempt will be made to outline in a general way a few practical rules for selecting and applying the most suitable lubricant for various operating conditions.

## Frictional Losses

In a strict sense, the term "anti-friction" as applied to ball and roller bearings is a misnomer. Under normal operation, the friction loss in a properly designed plain bearing may not differ greatly from that of a ball or roller bearing operating under similar conditions. This comparison is based on normal full speed operation and full fluid lubrication of the plain bearing. On the other hand, where conditions of boundary lubrication exist, such as sometimes encountered in starting or in a slow speed or oscillating type bearing, the friction loss in a plain bearing may far exceed that of an anti-friction bearing. Herein lies some of the important advantages of the anti-friction bearing, viz., low starting torque, and low friction losses under conditions of boundary lubrication.

Friction loss in a ball or roller bearing is due to several factors:

(1) Rolling friction due primarily to deformation of the rolling elements and races.

(2) Sliding action between the rolling elements and the cage or separator.

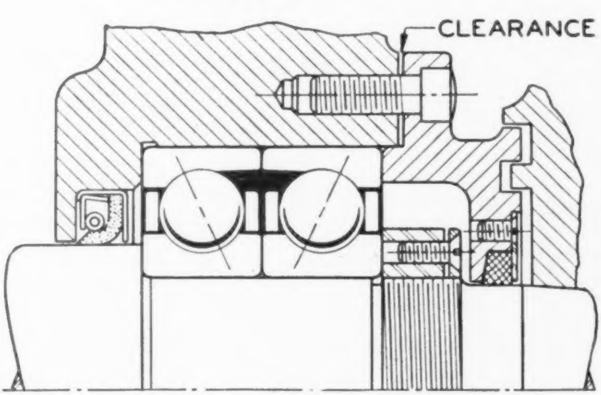
(3) Friction developed by the bearing seals.

(4) Internal friction of the lubricant itself.

When a load is applied to an anti-friction bearing, some deformation of the metal of the balls or the rollers and of the races takes place. This is unavoidable; otherwise the load carrying area would be zero and the resultant stress would be infinite. Obviously, this condition cannot exist. This deformation, together with the fact that all parts of the rolling elements in the contact area do not revolve at the same speed, results in a deviation from pure rolling action. This partial sliding in combination with the deformation of the rolling elements and races represent the primary frictional losses in a properly designed and lubricated anti-friction bearing.

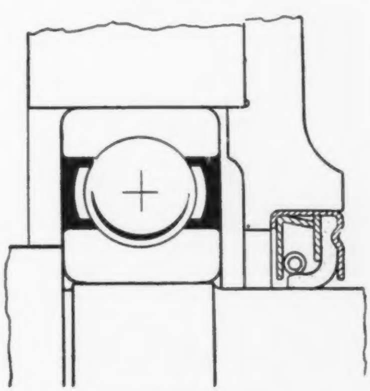
Due to the relatively small bearing area, the unit pressures between the rolling elements and the races of anti-friction bearings are extremely high. Research by Heinrich Hertz and others indicates that, for conventionally loaded ball bearings, the compressive stress at the center of the pressure area may reach 450,000 to 750,000 p.s.i. It is, therefore, questionable whether an unbroken film of lubricant is ever maintained in this high pressure zone. The fact, however, that bearing failure will usually occur relatively soon in the absence of a lubricant, indicates that a film does exist, at least to the extent of boundary lubrication. It is generally recog-

**FIGURE 1**




BEARING SEAL
for exclusion of foreign matter

**FIGURE 2**



BEARING SEAL
for retention of lubricant

nized that the lubricant performs a dual function in this high pressure area, viz.,

(1) Dissipates or distributes the heat generated by the deformation of the rolling elements and races, and

(2) Lubricates the sliding surfaces.

Except in high speed lightly loaded bearings, the friction between the rolling elements and the separators or cage is generally of secondary importance since the pressures involved are relatively low. Any lubricant that satisfies the other requirements of the bearing will generally lubricate these surfaces satisfactorily. This also applies to the friction developed by the bearing seals.

As previously mentioned, when considering the lubrication of anti-friction bearings, the internal friction of the lubricant itself should not be ignored. This may be of appreciable magnitude especially under conditions of high speed. The viscosity of the lubricating oil or the consistency and nature of the lubricating grease as well as the amount of lubricant present, all are important factors influencing the internal friction loss. In general, for oil lubricated bearings, the lowest viscosity and the least amount of oil that will properly lubricate and cool the bearing is the best recommendation. Other factors which influence the selection of the lubricant will be discussed later.

## Bearing Seals

The second function of the lubricant is to help prevent entry of foreign matter into the bearing. This is important where excessive amounts of abrasive materials such as coal or rock dust are present. Exclusion of foreign matter is generally more effectively accomplished through the use of grease lubrication. Grease tends to form a seal in the clearance spaces of the bearing housing, thereby trapping the foreign matter before it enters the path of the balls or rollers. Bearings operating under such conditions may be advantageously lubricated by pressure gun or by a centralized greasing system. Grease should be applied in sufficient quantity to insure a constant supply of fresh lubricant to the bearing, thereby flushing out any dirt that has passed the bearing seals. Proper design of bearing seals, however, is necessary when this procedure is followed. Seals should be designed to prevent, insofar as possible, the entry of foreign matter but should permit excess lubricant to be readily expelled from the bearings. Many types of seals are available, complete details of which are outside the scope of this paper.

FIGURE 1 illustrates a garter type bearing seal, mounted at the left of the bearing with the flange pointed outward. This arrangement has maximum effectiveness in the exclusion of foreign matter and permits introduction of grease by means of pressure application without danger of rupturing the seal. Excess lubricant is readily expelled between the shaft and the flange of the seal. High speed bearings, however, may require auxiliary means for removal of excess grease, such as described later in this article.

FIGURE 2 illustrates the use of a garter type bearing seal with the flange pointed toward the bearing. This arrangement is usually preferred where retention of the lubricant is the primary consideration, but is not recommended where the bearing is pressure lubricated unless provision is made to permit the escape of excess grease through a suitable relief valve or other device.

## Heat Dissipation

The third function of the lubricant, viz., heat dissipation or removal, is generally best accomplished through the use of oil rather than grease. In some installations, such as dryer roll bearings of paper machines, hot roll bearings of steel mills, etc., circulating systems with oil coolers are necessary to properly cool the bearings and promote good lubricant and bearing life. In general, grease lubrication should be avoided where bearing temperatures exceed 250° F. or where the lubricant is called upon to perform the additional function of removing transmitted heat.

## Corrosion Prevention

While the prevention of rust and corrosion is not primarily a lubricant function, it is a problem with which the lubricant supplier is often confronted. Sometimes it is difficult to prevent the entry of water or other corrosive materials into the bearings or the lubricating system. The use of a suitable corrosion inhibitor in the lubricant has to a great extent been helpful in overcoming some of these corrosion difficulties. Certain types of lubricating greases are inherently good rust preventives. Soda soap greases for instance are superior to calcium soap greases in this respect. On the other hand, calcium soap greases have better resistance to water washing where large quantities of water are present. Therefore, careful selection of the lubricant is extremely important where operating conditions are such that corrosion troubles are likely to be encountered.

## Selection of Lubricating Oils

It is generally conceded that oil is preferable to grease for the lubrication of anti-friction bearings where one or more of the following conditions exist:

(1) Speeds are high.

(2) The bearing requires cooling as well as lubrication.

(3) High bearing temperatures (usually above 250° F.).

(4) Design and operating conditions are such that the oil can be retained without excessive leakage.

(5) Other parts of the machine require oil which can be supplied from a common lubricating system.

The viscosity of the oil best suited for the lubrication of antifriction bearings is generally selected empirically, from the size of the bearing, its speed, and average operating temperature. As previously pointed out, unit pressures in anti-friction bearings are generally far in excess of the film strength of the lubricant. Therefore, unless loads are unusually severe or excessive shock loads exist, it is common practice to disregard bearing loads when selecting oil viscosity. Other conditions being equal, higher speeds require lighter oils, while higher temperatures indicate heavier oils. Charts and tables have been prepared which may be

used as a guide in selecting oil viscosity. In most of these charts, the bearing bore is considered, as well as the r.p.m. The product of the bearing bore in mm. multiplied by the r.p.m. is called the speed factor. The speed factor and operating temperature is then used to determine the viscosity of the lubricating oil.

TABLE I is included for use as a guide in selecting the proper oil viscosity for ball or roller bearings. In general, the higher limits of the viscosity ranges shown in this tabulation are applicable to the lower limits of the speed factor ranges and viceversa. The lower viscosities are also applicable to the lower limits of the temperature ranges.[3]

It is important that only high-grade oils having good oxidation stability be recommended for the lubrication of anti-friction bearings, particularly where temperatures are above normal. Inferior oils may oxidize rapidly, forming gummy residues and lacquers which clog the small clearance spaces and interfere with free action of the rolling elements. This increases bearing friction, thereby further raising operating temperatures. Thus a vicious cycle may be set up, which accelerates both lubricant and bearing failure. Good oxidation stability, therefore, is one of the most important characteristics of anti-friction bearing lubricants.

For heavy duty applications, experience indicates that lubricants having high film strength may be desirable. Where extremely heavy or shock loads are encountered, such as in steel mill roll neck bearings, it is common practice to recommend e.p. lubricants. If load conditions are normal but operating temperatures are high, for example in paper mill dryer roll bearings, special oils having high film strength and superior oxidation stability are generally advantageous. The part played by the extreme pressure or high film strength characteristics of the lubricant is, however, somewhat obscure, since normal failures of anti-friction bearings are generally conceded to be due to metal fatigue rather than a deficiency in the film strength of the lubricant.

## Selection of Lubricating Greases

Grease is applicable and is generally preferred for the lubrication of anti-friction bearings where one or more of the following conditions prevail:

(1) Bearing seals are not adequate to retain oil.

(2) Maximum protection against entry of contaminants is desired.

(3) Bearings are so located as to receive infrequent attention.

(4) Speeds are low.

(5) Bearing temperatures are not excessive

(6) Where other parts of the machine require grease and a centralized greasing system is desirable.

The selection of the proper grease for the lubrication of anti-friction bearings is usually somewhat more complicated than is the choice of a suitable oil. The primary function of the grease is to reduce the friction loss in the bearing to the lowest possible degree. To accomplish this, it is generally

[3]Tabulation is based on satisfactory field experience and has been compiled after taking into account the recommendations of several leading ball and roller bearing manufacturers. Oil viscosity selection charts are also published by many of the anti-friction bearing manufacturers. A typical chart is shown in New Departure Engineering Service Bulletin Part 3, which covers "Enclosure & Lubrication of Ball Bearings".

TABLE I

| Operating Temperatures °F. | Speed Factor Bearing Bore (MM.) x R.P.M. | Viscosity S.U.V. @ 100°F. | @ 210°F. |
|---|---|---|---|
| —40 to +32 | Up to 75,000 | 70 to 150 | |
| | 75,000 to 200,000 | 50 to 100 | |
| | 200,000 to 400,000 | 50 to 70 | |
| | Above 400,000 | 40 to 60 | |
| 32 to 150 | Up to 75,000 | 150 to 600 | |
| | 75,000 to 200,000 | 100 to 300 | |
| | 200,000 to 400,000 | 70 to 200 | |
| | Above 400,000 | 60 to 150 | |
| 150 to 200 | Up to 75,000 | 600 to 1200 | |
| | 75,000 to 200,000 | 300 to 600 | |
| | 200,000 to 400,000 | 150 to 300 | |
| | Above 400,000 | 100 to 200 | |
| 200 to 250 | Up to 75,000 | 1100 to 3000 | 95 to 155 |
| | 75,000 to 200,000 | 700 to 2100 | 75 to 125 |
| | 200,000 to 400,000 | 400 to 900 | |
| | Above 400,000 | 300 to 600 | |

necessary that the grease have a combination of several of the following characteristics:

(1) A melting point or dropping point suitable for the particular application. This may not be important except for high temperature applications.

(2) A minimum change in consistency with working. This is important from the standpoint of leakage.

(3) Proper consistency so as to channel rather than churn and cause excessive friction loss. Churning or excessive agitation of the lubricant generally results in high bearing temperatures. This should be avoided, particularly in high speed bearings. This will be discussed more fully under the heading of "Grease Consistency".

(4) Minimum internal resistance to shear. This characteristic is important, particularly in high speed bearings, and where starting torque must be kept to a minimum.

(5) Good adhesive characteristics.

(6) Minimum tendency to leak past bearing seals.

(7) Resistance to water washing.

(8) Corrosion preventive properties.

(9) Good oxidation stability.

(10) Ability to seal bearings against entry of foreign matter.

(11) Low torque and good pumpability characteristics at low temperatures.

It is usually difficult to evaluate the suitability of a grease for a given application through laboratory examinations alone. Supervised application of the product over a long period of time under actual operating conditions is generally the best yardstick for measuring the performance of any lubricant. Laboratory equipment, however, is extremely useful in obtaining certain physical characteristics of greases such as those outlined above. We are including as a matter of interest reproductions of photographs taken at Gulf Research and Development Company, Harmarville, Pennsylvania, which show some of the tests used to evaluate the lubricating characteristics of greases.

FIGURE 3 shows Mr. J. Parise, Technician, obtaining the dropping point of lubricating greases by A.S.T.M. Procedure D 566-42. In this test, grease specimens are placed in a chromium plated brass cup of specified dimensions having a 7/64" diameter orifice at the bottom. The cup is placed in a test tube, with a thermometer inserted so as not to restrict the orifice, and the entire assembly is then heated at a specified rate in a bath of oil. As the melting point of the grease is approached, the heating rate is adjusted to maintain a difference of 2° to 4° F. between the temperatures in the test tube and the oil bath. The temperature is increased gradually until a drop of grease falls from the orifice at the bottom of the grease cup. The average of the oil bath temperature and the temperature within the test tube is taken as the dropping point of the grease. While this test is the accepted procedure for determining the temperature at which grease passes from a semi-solid to a liquid state, it should be remembered that it has no particular significance as regards the service performance of a grease. Normally, it is not good practice to subject ball bearing greases to operating temperatures anywhere near their A.S.T.M. dropping points, since their service life would be entirely too short due to rapid oxidation at these temperatures.

FIGURE 4 shows Mr. T. R. Orem, chemist, obtaining the cone penetration of a grease by A.S.T.M. Procedure D 217-48. This is the generally accepted method for determining the consistency of lubricating greases both before and after working. The depth in tenths of a millimeter that a standard cone penetrates the sample in a given time interval (5 sec.) at a specified temperature (77° F.) is the "penetration" of the grease. The weight of the cone and movable attachments is 150 grams. This test is sometimes useful as an indication of the mechanical stability of a grease. By comparing the penetration of a grease before and after working a specified number of strokes in a standard grease worker, some indication as to the retentivity of the lubricating grease in a ball bearing may be obtained.

FIGURE 5 shows Mr. E. S. Francis, chemist, making torque readings on a B.E.G. grease testing machine. Essentially this machine consists of an electric motor direct connected to a vertical shaft, on the lower end of which is mounted a ball bearing packed with a given amount of grease to be tested. The outer race of the bearing is clamped to the bearing housing which tends to rotate due to frictional resistance within the bearing. Rotative motion of the housing is limited by connection to a suitable torque indicator. As the inner race of the bearing is rotated, the torque required to overcome resistance caused by the lubricant is read on the vertical scale. A cup containing an oil bath surrounds the bearing housing. The oil bath temperature is controlled by means of an electric heating element and a suitable thermostat. This machine may also be used to determine other characteristics of ball bearing lubricating greases, such as:

(1) Leakage.

(2) Rise in temperature due to working.

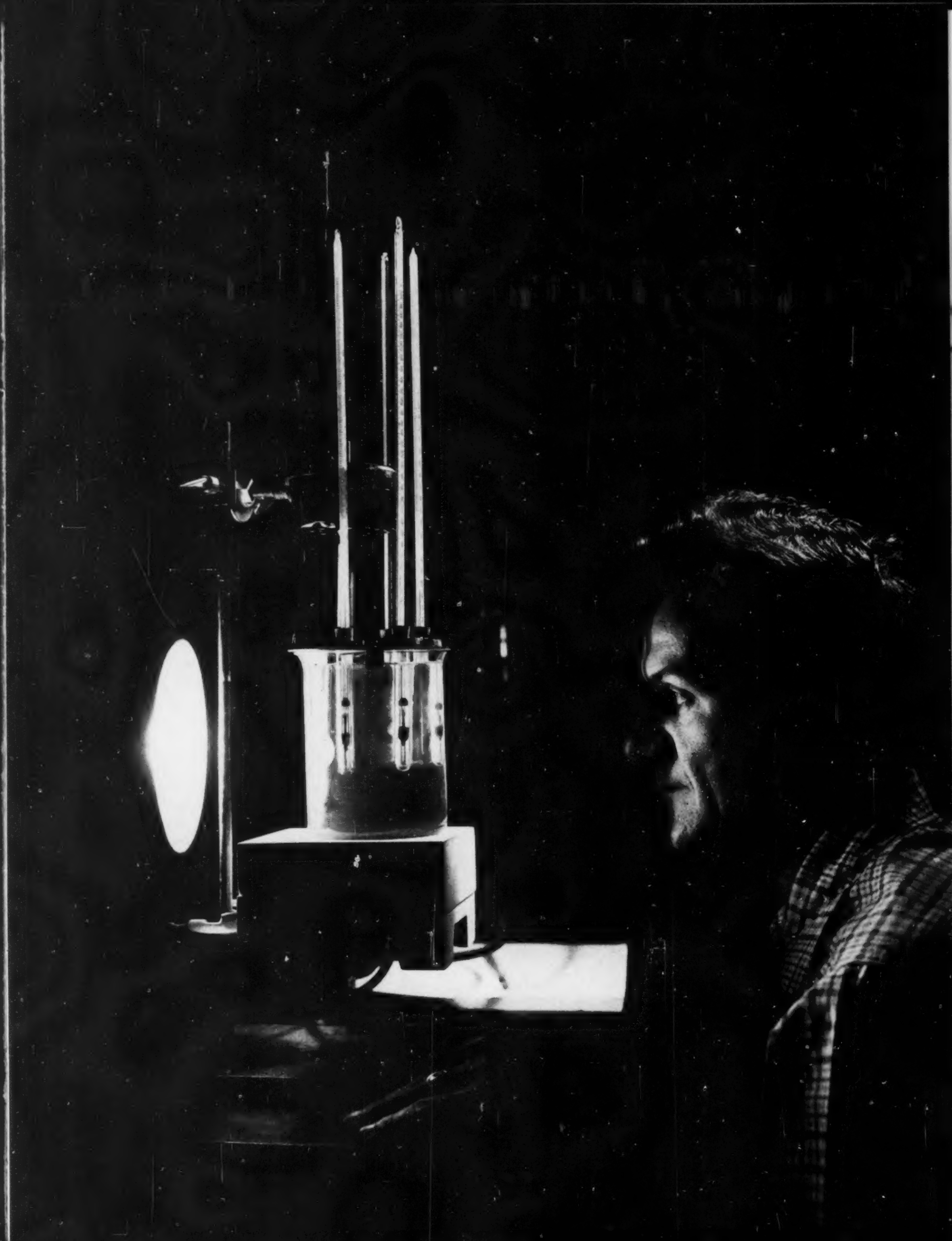
(3) Aeration characteristics.

(4) Separation.

(5) Change in structure.

FIGURE 6 shows Mr. A. Fricioni, chemist, obtaining the oxidation stability of lubricating greases by the oxygen bomb, A.S.T.M. Procedure D 942-50. As defined in the test procedure under Scope, this test is used as a means of evaluating the resistance of greases to oxidation when stored under static conditions, such as thin coatings of grease on

FIGURE 3, right, shows Technician J. Parise obtaining the dropping point of lubricating greases by A.S.T.M. Procedure D 566-42.



anti-friction bearings while in storage. It should be borne in mind that this test does not correlate with, and is not intended to predict the oxidation stability of greases under dynamic conditions such as encountered in actual lubrication service. Essentially, this test consists of placing 4 grams of the test grease in a standard sample dish, inside a stainless steel bomb of prescribed material and dimensions. The bomb is filled with oxygen at 110 p.s.i. pressure and immersed in an oil bath maintained at 210° F. The degree to which the grease is oxidized after a period of time is indicated by the corresponding drop in oxygen pressure within the bomb.

FIGURE 7 shows Mr. S. A. Flesher, engineer, examining an anti-friction bearing in the Gulf Wheel Bearing Machine.[4] This machine is used to evaluate the anticipated life of lubricating greases under controlled test conditions usually chosen to simulate actual operation. Accelerated tests, however, can also be made on this machine. Bearings are packed with a given amount of lubricant and operated under controlled conditions of speed, temperature, and load. At periodic intervals, the bearings are inspected to determine the condition of the grease as well as any indication of mechanical failure of the bearings. The test is usually continued until failure of the bearing or of the lubricant occurs. A test may be terminated, however, for one or more of the following reasons:

(1) A sudden rise in temperature above the controlled temperature.

(2) Dry race paths.

(3) The end of a predetermined time.

(4) Appearance of pits in the rolling elements or races.

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[4]A description of the Gulf Wheel Bearing Machine appeared in Mr. R. J. S. Pigott's paper, "Some Test Equipment for Greases," presented to NLGI in 1947. Another paper entitled "A Machine for Performance Tests of Anti-Friction Bearing Greases," by P. G. Exline and S. A. Flesher was presented at the annual meeting of NLGI at Chicago in October 1944.

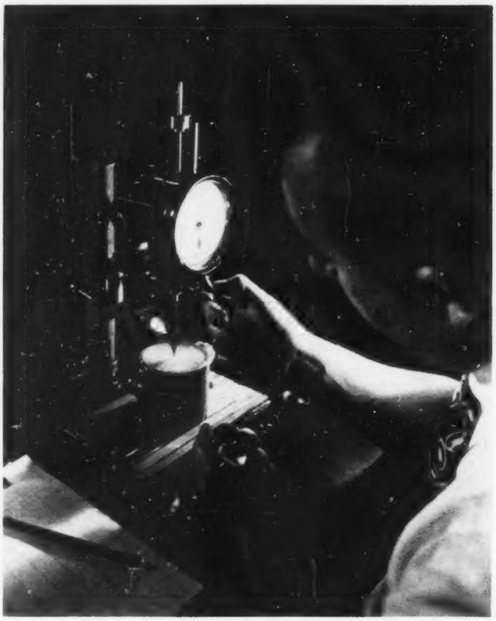


FIGURE 4, the cone penetration of a grease by A.S.T.M. Procedure D 217-48 is obtained by Chemist T. R. Orem.

It is often impossible to select a grease having all the desired properties. In this case, a compromise is necessary and considerable study may be required to select the grease best suited to a particular combination of operating conditions.

Grease manufacturers have done a great deal of research work in an endeavor to provide in a single grease all the characteristics which are necessary for the majority of anti-friction bearing applications. Much has already been accomplished in this direction. It is still necessary, however, to make several types of lubricating greases, each of which has characteristics especially suited for certain operating conditions. The following factors generally determine the type of grease best suited for a particular installation:

(1) Operating temperatures.

(2) Speed.

(3) Load.

(4) Contaminants entering the bearing (water, acids, etc.).

(5) Effectiveness of bearing seals.

Where operating temperatures are moderate, speeds not excessive, and where bearing seals are inadequate, necessi-

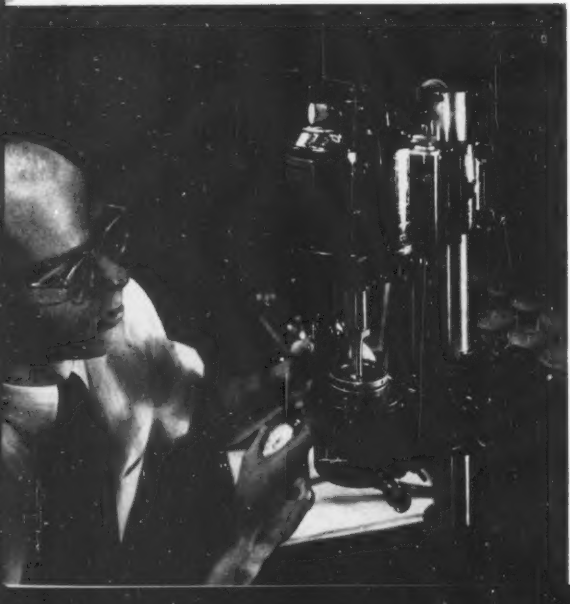


FIGURE 5 shows E. S. Francis, chemist, making torque readings on a B.E.G. grease testing machine.

FIGURE 6, Chemist A. Fricioni obtains the oxidation stability of lubricating greases by the oxygen bomb, A.S.T.M. Procedure D 942-50.

tating frequent application of the lubricant, calcium base greases may be recommended. Calcium base or other good water resistant greases are usually preferred where severe water washing action is present.

The majority of the conventional high-grade ball and roller bearing greases in use today are those manufactured from sodium soaps or from a mixture of sodium and calcium soaps. These greases are generally more stable and are suitable for a wider operating range as far as temperature and speeds are concerned than are other well-known greases such as the calcium or aluminum base types. In general, sodium base greases are less resistant to water washing action than are calcium and aluminum base greases. On the other hand, the ability of sodium base greases to absorb moderate amounts of water (up to approximately 50 per cent of their own volume) in the form of an emulsion and still retain their lubricating properties is in some instances advantageous. This characteristic incidentally enhances their rust preventive properties. Soda base greases, therefore, are often recommended in preference to other types where moderate amounts of water are present.

## Multi-Purpose Lubricants

Greases have also been developed containing soaps of other metals such as lithium, barium, or strontium. Oils thickened with clay, silica, or metallic silicates, but containing no soap of the conventional type, have recently entered the picture. The bentone greases[5] are examples of the non-soap-thickened lubricants. Most of these greases have been produced in an effort to provide in a single product one lubricant that would be suitable for a multiplicity of operating conditions. For instance, some of these materials combine the characteristics of good water resistance and high melting point to a greater degree than is possible with the more conventional types of greases.

To what extent multi-purpose lubricants will replace established sodium and calcium base greases for the lubrication of anti-friction bearings is at this time unpredictable. However, present indications are that there is a field for greases of the multi-purpose type, particularly where supervised lubrication procedure is lacking to such a degree that proper application of two or more greases would be difficult to maintain, or where some compromise as to lubricant suitability is permissible. It should be remembered, however, that where severe service conditions prevail involving high temperatures and high speeds, particularly where maximum resistance to oxidation is desired, the performance characteristics of conventional soda base and soda-lime base greases are still unsurpassed. For this reason, it appears doubtful that multi-purpose greases will, in the foreseeable future, entirely replace the better grades of currently established ball and roller bearing greases.

Since multi-purpose lubricants are relatively new, their ultimate performance characteristics and their possible fields of application have not yet been fully explored. However, present indications are that greases of the lithium, barium, or strontium base type may find favorable customer acceptance for many applications, particularly where reduction in number of brands is of primary importance.

### Lithium Base Greases

Lithium base greases have A.S.T.M. dropping points of approximately 350° F. They have fairly good oxidation stability at high temperatures combined with good water resistance. These characteristics, in addition to good low temperature torque and pump-

[5]An article entitled "Bentone Greases," by C. Malcolm Finlayson, National Lead Company, and P. R. McCarthy, Gulf Research and Development Company, appeared in the May 1950 issue of *The Institute Spokesman*.

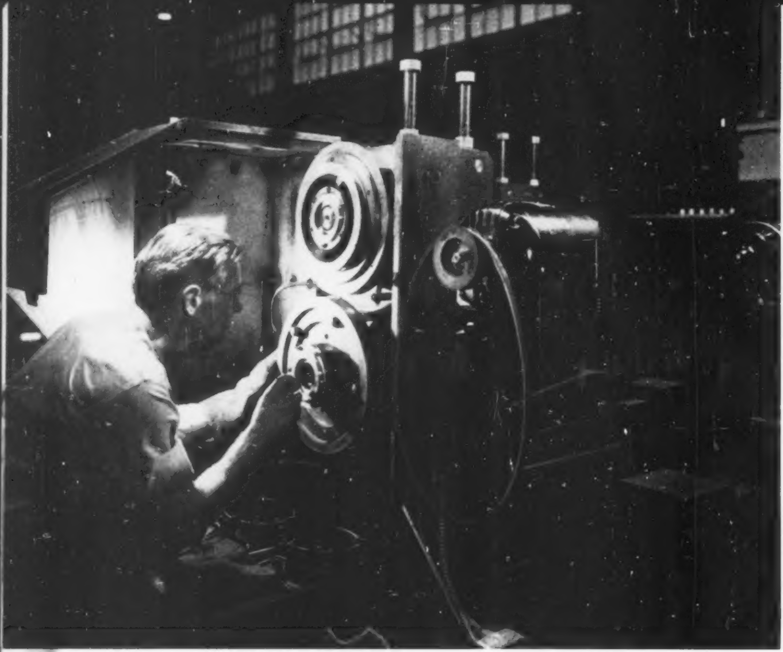


FIGURE 7, Engineer S. A. Flesher examines an anti-friction bearing in the Gulf Wheel Bearing Machine in order to evaluate the anticipated life of lubricating greases under controlled test conditions usually chosen to simulate actual operation.

ability characteristics, will probably adapt them to a wide variety of applications. To date, their manufacture has been somewhat restricted due to a shortage of lithium soaps. When this situation improves, it appears likely that lithium greases may become quite popular as general purpose automotive greases for use in service stations. Simplification of stocking problems and the elimination of possible errors in application are factors which can possibly justify the higher cost of lithium base greases as compared to many of the conventional automotive greases now in use. It is probable that the field of application for this type of lubricant industrially will also be expanded.

**Barium Base Greases**

Barium base greases have characteristics quite similar to lithium base greases. As currently developed, these greases appear to have properties slightly less favorable than lithium base greases for extremely low temperature applications. However, they do show evidence of having inherently better oxidation stability at high temperatures. Barium base greases have A.S.T.M. dropping points of approximately 400° F. They are highly resistant to water washing action, comparing favorably with calcium base greases in this respect.

**Strontium Base Greases**

The development of strontium base greases has not progressed as rapidly as has the development of lithium and barium base materials, possibly due to their higher cost. Therefore, the ultimate performance characteristics of these greases are not too well known at this time. Experimental work to date on strontium greases, however, indicates that they have characteristics quite similar to the lithium and barium base types. Compared with the other types of multi-purpose greases the performance of strontium base greases at high temperatures appears to be particularly favorable.

**Bentone Greases**

In addition to the multi-purpose greases mentioned above, petroleum base lubricants of the non-soap-thickened type, such as the bentone greases, appear to be enjoying considerable popularity. Unlike soap-thickened products, these greases do not have a distinct melting point. Their mechanical stability or resistance to consistency breakdown appears to be excellent. Bentone greases also have good adhesive characteristics and will withstand water washing action to a greater degree than conventional soda soap greases. The non-melting characteristics of bentone greases may be mistaken, however, as an indication that they are suitable for extremely high temperature applications. This is definitely not the case. The fact that a grease will not melt and run out of a bearing at an elevated temperature is no criterion as to its durability or oxidation stability at that temperature. Tests have shown that for temperatures around 250° F. (which is generally considered the upper limit for satisfactory performance of petroleum greases), bentone greases oxidize just as rapidly as other greases, and usually more rapidly than the better grades of

soda base, ball bearing greases. Although bentone greases have good water resistance characteristics, they are quite similar to other non-emulsifying greases in that they are inherently poor rust preventives. This deficiency, however, can be counteracted at an increased manufacturing cost through the addition of suitable rust preventives. As previously indicated, conventional soda base greases are generally a preferred recommendation where moderate amounts of moisture or water contamination are present.

### Special Greases

Greases manufactured from synthetic oils, such as silicone fluids, poly-alkene glycols, and certain of the di-esters are also available for special applications. These products are generally intended for operating temperatures which are outside the range for satisfactory performance of petroleum greases. Combined with special soaps, synthetic oils have been utilized to produce greases suitable for both extremely low and extremely high operating temperatures, as well as for use in applications involving widely fluctuating temperatures. Some of these greases are claimed to operate satisfactorily over a temperature range of —100° F. to +300° F.

Lithium base di-ester greases made their appearance during the last war primarily for aircraft service to meet Army-Navy Specification AN-G-25, which is now superseded by Specification MIL-G-3278. Characteristic of all synthetic lubricants in general, this material is much more expensive than petroleum greases. The use of products of this type industrially is, therefore, limited to those relatively few applications where petroleum greases are not suitable.

### Grease Consistency

After selecting the type of grease for a certain application, the consistency is perhaps the next most important consideration. The correct consistency grade to use depends on several factors, some of the most important of which are:

(1) Speed.

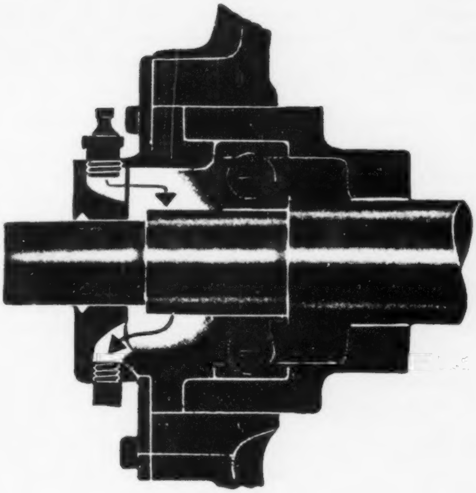
(2) Operating temperature.

(3) Method of application.

(4) Type and condition of bearing seals.

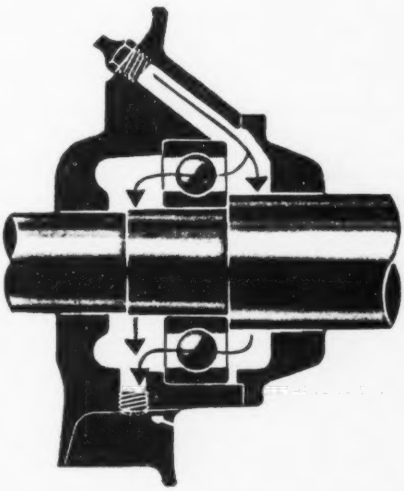
In general, other conditions being equal, the higher the speed, the harder should be the consistency of the grease. Harder greases tend to channel, so that the main grease supply remains outside the path of the rolling elements. The grease should then gradually flow or sag back against the balls or rollers, thus automatically feeding to the bearing surfaces as required. This minimizes agitation and reduces friction losses within the lubricant itself, thus promoting a cooler running bearing. For grease packed bearings with speed factors between 75,000 and 300,000, a grease of No. 3 NLGI consistency is generally satisfactory. However, if application is by pressure gun or by means of a centralized greasing system, a softer grease may be necessary, particularly where operating temperatures are below normal or where the grease is fed by pressure through long lines. With speed factors below 75,000, consistency is less critical so that a No. 1 or No. 2 NLGI grease is usually recom-

FIGURE 8



PRESSURE FITTING WITH RELIEF PLUG
(correctly located)
Courtesy U. S. Electrical Motors, Inc.

FIGURE 9



PRESSURE FITTING WITH RELIEF PLUG
(incorrectly located)
Courtesy U. S. Electrical Motors, Inc.

mended. For extremely low operating temperatures, especially where application is by pressure gun, a No. 0 consistency may be preferable. As previously outlined, the condition and type of bearing seals also influence the consistency of lubricating grease. If the seals are not adequate, a harder consistency is usually necessary.

### Quantity and Frequency of Application

Equally important to the selection of the type and consistency of the lubricant is that of maintaining the proper amount of lubricant in the bearing. Too much lubricant causes excessive friction within the lubricant itself, due to churning. This is one of the common causes of excessive bearing temperatures and unsatisfactory lubricant performance. Insufficient lubricant may cause rapid wear and eventual bearing failure. Over-greasing, however, is generally more prevalent and causes more damage than under-greasing.

In the case of grease lubricated bearings operating in the higher speed ranges (speed factors above 75,000), most authorities agree that the space surrounding the bearing should be filled from one-third to one-half full of grease. Overfilling is of less consequence in the case of slow speed bearings. Where slow and medium speeds are involved, particularly where dust and abrasive materials are present, it may even be desirable to completely fill the bearings in order to more effectively exclude the entry of foreign matter. Where the bearings are lubricated by means of a pressure gun or where a pressure greasing system is used, if speeds are such that excessive grease is detrimental, the bearing housing should be provided with a relief vent or other suitable device to permit the escape of surplus grease. A plugged relief hole is sometimes provided, in which case the plug should be removed before applying grease to the bearing. Sufficient grease should then be forced into the bearing so that some of the old grease is expelled through the relief hole. The machine should then be started and allowed to run until the bearing relieves itself of excess grease. (This may require 15 or 20 minutes). The relief plug should then be replaced.

FIGURE 8 shows a grease lubricated ball bearing equipped with a pressure fitting and relief plug. The relief plug, however, is not advantageously located with respect to the pressure grease fitting for correct passage of grease through the bearing housing. In this arrangement, the fresh grease introduced through the pressure fitting by-passes the bearing and is expelled through the relief hole, leaving the used grease in the bearing proper.

FIGURE 9 illustrates a better location of the relief hole with respect to the passage of grease through the bearing housing. In this design, fresh grease applied through the pressure fitting must pass through the ball bearing proper, thereby effectively forcing the old grease out through the relief hole.

FIGURE 10 shows another method of getting rid of excess grease from a roller bearing. In this design, grease introduced at the bottom of the bearing through a pressure fitting flows to the clearance space at the left of the housing, whence it passes through the bearing. The excess grease is retained in the end cover at the right, which may be removed at periodic intervals for bearing inspection and the removal of used lubricant.

FIGURE 11 shows two ball bearings mounted in a housing so arranged that excess grease is automatically expelled. Grease is introduced between the bearings, and after passing through them, enters the small clearance spaces at each end of the bearing housing. Rotating slingers or discs pick up the surplus grease and eject it from the bearing housing by centrifugal action. This arrangement is suitable for use with high speed bearings where an excessive amount of lubricant would cause overheating.

Frequency of re-lubrication required for a particular machine or plant depends entirely on the type of equipment and the operating conditions. Where dusty conditions and high temperatures prevail such as in the mining, rock products, and cement industries re-lubrication may be necessary once each shift, or even oftener. In other plants where operating conditions are more favorable, it is often possible to extend the re-lubrication period to weekly, monthly, or even yearly intervals. Your lubricant supplier, through experience gained in many installations of similar nature, is in a position to render assistance in determining the most economical re-lubrication procedure.

### Cleaning Anti-Friction Bearings

Equally important to proper lubrication is the matter of periodic cleaning of bearings and bearing housings. The most opportune time to clean bearings is generally during the regular overhaul of the machine or, in the case of rolling mill bearings, this may be tied in with established roll change procedures. In some instances, it may be desirable to provide spare bearings so that "down time" may be kept to a minimum. The process of cleaning and reconditioning the bearings may then proceed in a thorough and leisurely manner.

After dismounting, the bearings should be placed in a suitable wire basket suspended in a tank of solvent or cleaning fluid such as petroleum naphtha or kerosene. The basket may be agitated slowly at periodic intervals or left suspended in the cleaning agent over night. Light lubricating oil or turbine flushing oil, heated to 200° to 250° F. is also an excellent cleaning medium, and presents less fire hazard than generally accompanies the use of light petroleum solvents.

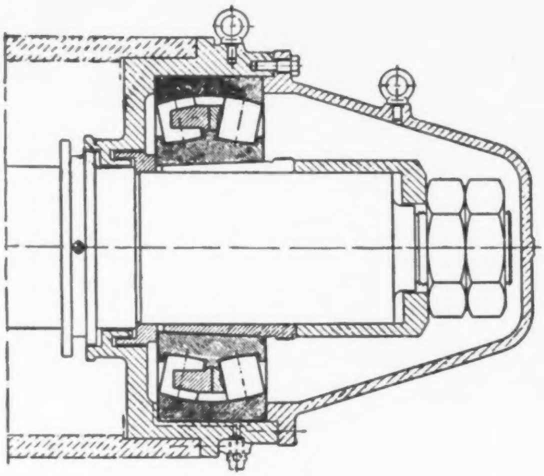
In cases where severe oxidation has occurred, boiling in suitable emulsifiable cleaners* in water may be effective. If hot water-emulsion cleaners are used, the bearings should be thoroughly drained, air dried, and immediately washed in petroleum solvent or hot oil to remove all traces of the emulsion cleaner.

If necessary, a brush may be used to dislodge large or solid particles of oxidized grease or foreign matter. The use of compressed air should be avoided and no attempt should be made to rotate or spin the races until they are free of all solid materials, and until an adequate oil film is present.

After the bearings are clean, they should be immersed in a rust preventive oil and rotated to thoroughly remove all cleaning agents, following which they should be immediately wrapped in clean oil-proof paper to exclude dust or other

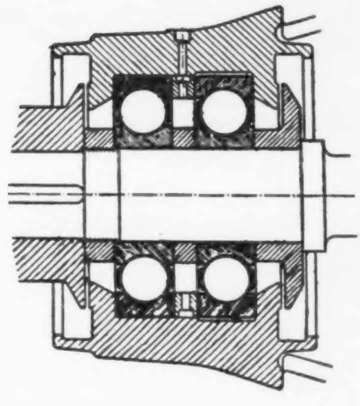
*Three to 4 oz. Tri-Sodium Phosphate per gal. of water or 1 oz Sodium Meta-Silicate per gal. of water.

**FIGURE 10**



GREASE LUBRICATED ROLLER BEARING
end cover
receives excess grease

**FIGURE 11**



GREASE LUBRICATED
BALL BEARING
with
grease valves or slingers

foreign materials. In the event the bearings are likely to be stored for long intervals, additional protection may be given them by packing with a suitable grease or rust preventive compound prior to wrapping.

Thorough cleaning of bearings that have not been dismounted is usually a more difficult procedure, and is not generally recommended except where it is not expedient to disassemble the bearings. In this event, hot flushing oil, heated to 180° to 200° F. may be directed through the bearing housings while the shaft is slowly rotated. Hot emulsion cleaners as previously described are sometimes used, followed immediately by hot flushing oil. An intermediate flushing with a mixture of alcohol and light petroleum solvent after the emulsion treatment may be useful in removing badly oxidized grease. In all instances, the cleaning fluid or flushing oil should be thoroughly purged from the bearings and housings prior to re-lubrication. This is best accomplished by flushing with lubricating oil heated to approximately 180° F., rotating the shaft several minutes, and again draining. The usual precautions with respect to fire hazards should be observed when petroleum solvents are used for cleaning bearings.

## Bearing Failures — Causes and Prevention

This discussion would not be complete without a brief reference to anti-friction bearing failures. When ball or roller bearings are installed in accordance with manufacturers' instructions, and are properly maintained and lubricated, their life expectancy can usually be predicted with a reasonable degree of accuracy. Except for certain high speed bearings, such as encountered in gas turbines[7], failure of anti-friction bearings is normally due to metal fatigue. Some authorities state that the fatigue life of ball bearings has been found to vary inversely as the fourth power of load and inversely as the speed.[8] Therefore, if the load on a ball bearing is reduced one-half, its life is increased 16 times. Also if its speed is doubled, its life is reduced one-half. Thus, if bearings are operated at loads and speeds in excess of those for which they are designed, their useful life may be seriously impaired. Premature failure of anti-friction bearings may be caused by many factors. Some of the more common causes of failure[9] are generally conceded to be:

(1) Excessive loads and speeds.

(2) Severe shock loading.

(3) Misalignment. This may be due to inaccuracies in mounting, deflections due to insufficient support, settling of foundations, etc.

(4) Damage to bearing through improper mounting procedures.

---

[7]A specialized application outside the scope of this paper.

[8]*New Departure Hand Book*—20th Edition. There appears to be some disagreement, as other authorities state fatigue life varies inversely as the third power of the load.

[9]For a more complete discussion on anti-friction bearing failures, see Pages 342-345 inclusive of *Rolling Bearings,* Second Edition, by R. K. Allan.

(5) Insufficient clearance to take care of expansion or contraction due to temperature changes.

(6) Entry of foreign matter into bearing, such as dirt, grit, rock or coal dust, etc., thus causing excessive wear. In this connection, cleanliness in storing, dispatching, and applying lubricants is extremely important. Small amounts of foreign or abrasive materials, which enter the lubricant through careless handling and storage procedures, are often the cause of abnormal bearing wear.

(7) Corrosion caused by water, acids, and other contaminants entering the bearing.

(8) Electrolysis due to stray currents, etc.

(9) Inadequate or improper lubrication.

(10) Defective bearing materials or workmanship.

It is an old adage that "an ounce of prevention is worth a pound of cure". Also "preventive maintenance is cheaper than corrective maintenance".

As previously stated, lubrication failures are relatively infrequent and far too often the lubricant has been unjustly blamed for premature bearing failures. Therefore, careful study to determine the cause of the failure and then taking suitable corrective measures, generally pays handsome dividends through lower maintenance costs, and increased machine output.

### Periodic Consultation Service

The proper application of lubricants in general involves highly specialized knowledge and experience. The lubrication of anti-friction bearings is no exception. In the average manufacturing plant, a large number of unrelated problems usually exist involving numerous grades of lubricants, fuels, rust preventives, cutting oils, quenching oils, solvents, and in some instances, waxes and various special process or technical oils. Relatively few companies find it feasible to develop within their own organization, the necessary knowledge and experience to solve all these problems consistently and economically.

Your petroleum supplier makes available a periodic consultation service to the end that effective help is given in maintaining efficient plant operation through the proper application of a minimum number of brands. This cooperative technical service is unique in that it is rendered without charge. We, of the petroleum industry, are proud of this service; without it, selling petroleum products would be a drab experience, devoid of a great deal of the personal satisfaction which is derived from a job well done.

# Patents and Developments

### Anhydrous Aluminum and Magnesium Soaps

Most of the aluminum and magnesium soaps produced today are made by the precipitation or double decomposition process, and a major difficulty with soaps so produced is claimed to be their lack of uniformity and their sensitivity to slight variations in production conditions.

In its Patent 2,582,833, Sherwin-Williams Co., describes a process for making completely anhydrous, soluble salt-free soaps by use of metallic aluminum or magnesium. This is done by adding 4-20 times the weight of the metal, of a dry aliphatic alcohol containing, in solution, a trace of a soluble mercury compound and then adding the free aliphatic fatty acid.

The free metal is preferably in a finely divided state, as in the form of turnings, foil or powder. The alcohol should contain less than 4 carbon atoms, while the amount of mercury compound is actually a trace, preferably .05 to .1 gm. per .1 mol. of aluminum.

In one example, 2.7 gm. of metallic aluminum turnings were placed in an agitated flask equipped with a reflux condenser. There was then added 12 gm. of methyl alcohol carrying a trace of mercuric chloride. The amount of alcohol was sufficient to completely cover the aluminum. The contents was gently heated until hydrogen started to become evolved, and 84 gm. of soya bean fatty acids in 378 gm. of mineral spirits was added. The mixture was agitated with slow heating to a slight refluxing of the alcohol until all of the aluminum was in solution. At this point, the temperature was raised and the excess methyl alcohol was distilled off. When cool, the final product was a thick, stringy gel in which the molar ratio of .1 mol. aluminum to 3 mols. fatty acid formed a neutral anhydrous soap.

It is believed that the mercury salt and alcohol serve as pseudo catalysts, the mercury amalgamating an area of the aluminum which, in turn, reacts with the alcohol to form the alcoholate which instantly reacts with the free fatty acid to form the soap.

### Extreme Pressure Greases

In preparing lead greases containing the soaps of lead and another metal, it has been customary to first prepare a grease containing the other metal and then add a separately prepared lead soap, followed by extended heating of the mixture to achieve proper distribution of the lead soap throughout the mixture. Socony-Vacuum Oil Co., in its U. S. Patent 2,583,394, finds that a good lime base grease may be prepared by mixing, at atmospheric temperature, the saponifiable material with litharge and lime and a monobasic fatty acid such as acetic acid, followed by heating under pressure to effect simultaneous saponification of all the materials. This is followed by a dehydration step.

Such a method is claimed to provide not only a superior, more stable grease, but also to result in substantial manufacturing economies. Since it permits the addition of acetic acid at room temperature to the kettle batch prior to saponification, partial loss by vaporization is avoided. Also, the separate preparation of metal acetates, followed by inefficient mixing thereof into the formed grease is avoided.

### High Temperature Grease

U. S. Patent 2,583,435, issued to Standard Oil Development Co., covers the preparation of a mixed base lubricating grease from an alkaline earth soap of a high molecular weight fatty acid and an alkali metal salt of a low molecular weight unsaturated acid.

The process involves mixing the desired amount of mineral oil base stock with the desired amount of a low molecular weight unsaturated acid, such as acrylic acid or nitrile, and charging the mixture into a grease kettle. The mixture is agitated and, during the agitation, the desired amount of alkali metal hydroxide in water solution is added. The resulting mixture is stirred to maintain an emulsion until the neutralization of the acid, after which the high molecular weight saturated fatty material (such as hydrogenated fish oil acids) is added.

Such fatty material preferably is mixed with a second portion of mineral oil which is added to the salt-containing mixture. The mass then is heated to insure solution of all the fatty material and, when this is complete, a slurry of the balance of the mineral oil and an alkaline earth base, sufficient to completely neutralize the fatty acid, is added to the mass. The temperature is raised until dehydration is complete, and the grease is allowed to cool.

The high molecular weight saturated fatty acid material may vary from ten to 20 per cent by weight, while the low molecular weight acid may vary from two to four per cent by weight. The alkaline earth hydroxide may vary from one to three per cent.

### Heavy Duty Lubricating Grease

An improved heavy duty grease for lubricating heavy machinery such as heavy automotive chassis elements, large gears, etc., is described in U. S. Patent 2,583,436 issued to Standard Oil Development Co. The material combines a metal soap thickener dispersed in a liquid lubricant consisting of a substantial proportion of an asphaltic residuum of high viscosity, and relatively high adhesivity or tackiness, the composition having a solid, firm, grease-like consistency without being unduly hard at lower temperatures. It has a high melting point and high shear stability.

The patent points out that heavy duty greases lacking asphaltic residuums also lack adhesivity. Furthermore, heavy asphaltic oils which do not have a grease consistency may lubricate gears effectively over a moderate temperature range, but they tend to run off the gears as the temperature rises.

One advantage of the patented product is claimed to be the fact that, while it is relatively water insoluble and is adequately resistant to water-leaching of the soda soap in it, it will emulsify small quantities of water without decomposition, thus distinctly improving its rust inhibiting properties.

While greases have been prepared in the past with a combination of soda soap and lead oleate, such products have shown a tendency to break down to semi-fluid products after severe mechanical working. The patented product, however, combines these ingredients with a dispersing agent (oil-soluble metal sulfonate) and with a viscous oxidized asphalt plus a relatively thin lubricating oil, to give a unique product having excellent structure stability to long mechanical working and does not break down to a fluid consistency under the high shearing stresses of meshing gears under high loads.

The patented grease preferably consists of 30 to 60 per cent by weight of an asphaltic residuum having a viscosity of about 1000 to 5000 S.S.U. at 210° F., 20 to 50 per cent of a suitable mineral lubricating oil of lighter viscosity, such as 35-300 S.S.U. at 210° F., 8 to 18 per cent of a suitable soap, preferably a sodium soap of rapeseed oil, though other soaps of fatty acids such as sodium stearate, calcium stearate and similar metal soaps of related $C_{12}$-$C_{22}$ fatty acids, may be used. The composition also includes about 1 to 15 per cent of an extreme pressure additive. Lead oleate is preferred for this purpose, preferably in proportions of about 7 to 12 per cent. Also chlorinated or sulfurized fatty oils, phosphorus compounds, etc., may be added. It is desirable also to use a small amount (about 0.2 per cent) of an oil-soluble sulfonate, preferably of 450 or higher molecular weight. The grease should remain solid at least up to 250° F.

One example of a suitable grease composition is given as follows:

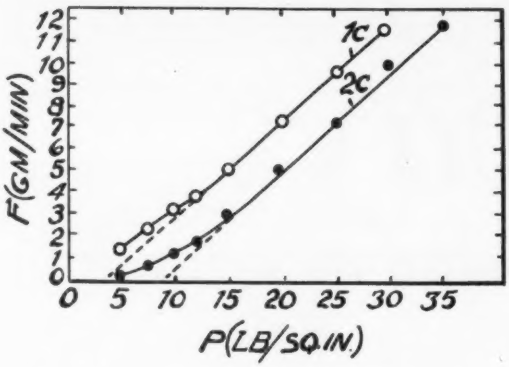
15.0 per cent rapeseed oil
3.2 per cent caustic soda
31.6 per cent mineral oil, 50 S.S.U. at 210° F.
0.2 per cent sodium sulfonate (mol. wt. about 450-500)
30.0 per cent asphaltic residuum, 2500 S.S.U. at 100° F.
20.0 per cent lead oleate concentrate (50 per cent mineral oil).

### Inorganic Gel-Thickened Grease

A series of patents has been issued to the Honorary Advisory Council for Scientific and Industrial Research of Canada on lubricating greases thickened with inorganic colloidal materials. The first patent, U. S. 2,583,603, discusses the importance of particle size and fiber length upon the viscosity of the resulting grease and the effect of water thereon.

In this patent, a method is disclosed for extracting water from the silica gel and providing a water-repellent coating for the solid phase at the dineric interface. This may be done

FIGURE 1




by passing styrene or butadiene over the dry aerogel in a heated tube. The silica gel products obtained are greasy to the touch and tests indicated that this repellency continued when 20 gm. of grease was added to 200 cc. of water at 70° C. and stirred mechanically for 15 minutes. Monomeric styrene also may be polymerized on the surface of the silica gel by adding 2 per cent of styrene to the oil before incorporating the siliga gel and thereafter placing the prepared grease in an oven at 100° C. for two days. Better results are obtained by adding 0.25 to 2 per cent of polystyrene dissolved in chloroform directly to the grease, followed by flashing off the chloroform.

Among the other inorganic thickeners which may be so waterproofed are ferric hydroxide, carbon black, cuprene, aluminum hydroxide, suzorite, vermiculite, graphite talc, etc.

Figure I shows the flow-pressure relationship for silica aerogel greases containing 10 per cent by dry weight of gel, based on the total composition in oil of 300 S.U.S. viscosity at 210° F. and viscosity index of 95. The upper curve, 1C, of the figure represents the grease treated with 1 per cent of polystyrene, whereas the lower curve, 2C, represents the untreated grease.

# PEOPLE in the Industry

## Jack H. Kellerman and Lee W. Beckmeyer Join Sales Staff of Southwest Grease and Oil Company

LEE W. BECKMEYER

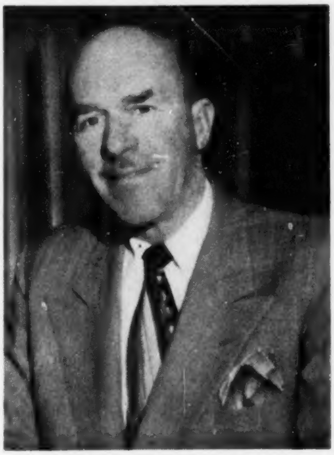
Southwest Grease and Oil Company announces the appointment of two men to its staff of sales representatives.

Jack H. Kellerman of 14451 South Brand Boulevard, San Fernando, California, is sales representative in California and Arizona.

Mr. Kellerman brings over twenty years of sales and lubrication experience and will be of valuable service to the refineries and compounders of his territory.

Lee W. Beckmeyer is sales representative in Kansas, Missouri, Illinois, Iowa, Nebraska and Colorado.

Mr. Beckmeyer graduated from high school in Centralia, Illinois, and attended the University of Illinois. Since that time he has been associated with the oil industry, except for three years service in the U. S. Navy in the Pacific Fleet during World War II.



JACK H. KELLERMAN

### Robert J. Painter Succeeds John K. Rittenhouse As ASTM Treasurer

The American Society for Testing Materials, through Executive Secretary C. L. Warwick, has announced the appointment of Robert J. Painter as treasurer of the society, effective April 15. He succeeds John K. Rittenhouse, who has retired after 43 years of service with this national technical group. It was also announced that Dorothy P. Douty would be assistant treasurer.

Following graduation from Rensselaer Polytechnic Institute with a degree of Civil Engineer, Mr. Painter was on the Rensselaer faculty for a time, later with the Bethlehem Steel Company, and has been on the ASTM staff since 1931. He will continue to be assistant secretary, to which office he was appointed in 1946. He will also continue as associate editor of the ASTM bulletin and handle various technical contacts as in the past.

Miss Douty, as assistant treasurer, will be directly in charge of accounting and many financial records, and will also assist in connection with budgets and ASTM investments.

Mr. Rittenhouse, retired treasurer, was the first full-time employee of the society, beginning in 1909. He was closely associated with the society's first secretary, Dr. Edgar Marburg, and after many years as assistant treasurer he was appointed treasurer in 1946. He and Mrs. Rittenhouse, long-time Philadelphia residents, will make their home in Rochester, New York, with their son.

### Deep Rock Names W. R. Seuren To Industrial Sales Post

William R. Seuren has been named industrial sales representative of Deep Rock Oil Corporation, announces W. W. Rice, manager, special product sales.

In his new position, Mr. Seuren will contact industrial trade in Deep Rock's expanded sales territory, from northern Illinois to Minnesota and certain industrial sections of Canada. For the past year Mr. Seuren has been supervisor of lube oil finishing at Deep Rock's refinery at Cushing, Oklahoma.

### J. S. Leach Appointed Head Of API's Study Committee On Special Projects

J. S. Leach, of The Texas Company, New York, has been appointed chairman of the American Petroleum Institute's Study Committee on Special Projects, it was announced today by President Frank M. Porter.

Mr. Leach succeeds A. Jacobsen, president of Amerada Petroleum Corp., in the chairmanship. Other members of the committee are as follows:

A. E. Johnson, of Argo Oil Corp., Denver; P. E. Lakin, Shell Oil Co., San Francisco; N. C. McGowen, of United Gas Pipe Line Co., Shreveport, Louisiana; R. L. Minckler, of General Petroleum Corp., Los Angeles; E. L. Shea, of The Ethyl Corp., New York; A. A. Stambaugh, of The Standard Oil Company (Ohio), Cleveland; Henderson Supplee, Jr., The Atlantic Refining Co., Philadelphia; W. K. Warren, Warren Petroleum Corp., Tulsa; and Burl S. Watson, Cities Service Co., New York.

## Paul A. Newton Receives Baroid Sales Appointment

Paul A. Newton was recently named East Texas District Superintendent for Baroid Sales Division, National Lead Company. He will maintain offices in Tyler, Texas, for the firm, which supplies drilling mud products, mud testing equipment and related services to drillers.

PAUL A. NEWTON

Mr. Newton majored in science and mathematics at Upper Iowa University, and prior to his joining Baroid in 1946 had been a science instructor and a Navy navigation officer. His experience with Baroid includes work in south Texas and south Louisiana fields. Since March, 1951, he had been stationed at Corpus Christi.



## Seven Speakers Listed For API's Lubrication Committee

Seven speakers have been signed up for the next meeting of the Lubrication Committee of the American Petroleum Institute, to be held in Tulsa, May 26-27-28, it was announced recently by Chairman B. G. Symon of Shell Oil Co.

Mr. Symon said the program for the three-day meeting, which was arranged by W. M. Murray of Deep Rock Oil Co., Tulsa, is one of the committee's best to date. He added that "We are particularly fortunate to have an outstanding array of speakers, all of whom will speak on subjects of primary interest to lubrication men and marketers."

Six of the speakers will address the general session scheduled for Tuesday, May 27, while the seventh will address the banquet meeting that evening. General session speakers lined up by Mr. Murray are as follows:

E. T. Knight, Atlantic Refining Co., Philadelphia; M. D. Gjerde (cqt), Standard Oil Company (Indiana), Chicago; H. C. Mougey, General Motors Research, Detroit; Bruce Boehm, Enjay, Inc., New York; D. F. Hollingsworth, The duPont Company, Wilmington, Del., and R. W. McDowell, president of Mid-Continent Petroleum Corp., Tulsa.

Mr. Boehm is scheduled to discuss "Factors in the Additive Treatment of Top Quality Motor Oils;" Mr. Hollingsworth, "The Importance of Lubrication to Industry Management;" Mr. McDowell, "Lubricants and Their Importance to the World," and Mr. Knight, the subject of supply, demand and general economics affecting the lubricants industry.

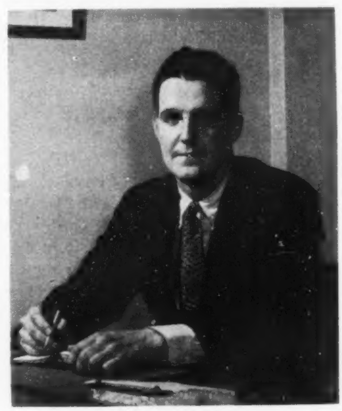
Neither Mr. Gjerde, who is chairman of the SAE Fuel and Lubricants Technical Committee, nor Mr. Mougey have selected their subjects and titles yet.

Dr. Harold Vagtborg, president of Southwest Research Institute, San Antonio, will be the speaker for the Tuesday evening banquet session. He will talk about "Science on the World Front."

The Operating Committee will meet Monday (May 26) and the Business Meeting will be held Wednesday (May 28). Among the items on the agenda for the business meeting are further discussion of the new motor oil designations and an educational program to put the new designations across to the petroleum and automotive industries and the public.

## Fentress Joins Foote As Sales Engineer

James Fentress, formerly Research Assistant at Northwestern University, has now joined Foote Mineral Company as sales engineer. Mr. Fentress obtained his degree in chemistry at Princeton University in 1944 and since that time has been closely identified with the Atomic Energy Commission and the Naval Bureau of Ships in Chemistry and Physics. In addition to his work at Northwestern he was associated with the University of Chicago and the Hanford Laboratories.



JAMES FENTRESS

Mr. Fentress, a native of Winnetka, Illinois, is a member of the society of Sigma Xi as well as both the Electrochemical and American Chemical Societies.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# Industry NEWS

### Emery Will Begin New Revolutionary Ozone Oxidation Process

Emery Industries, Inc., of Cincinnati, Ohio, has just received Government permission to start construction on its new, two-million-dollar plant for the oxidation of oleic acid by ozonization.

With this announcement Emery Industries disclosed the results of an extensive research program during which its chemists and engineers cooperated with the Welsbach Corporation of Philadelphia, to reduce to practice the first large-scale use of ozone in a chemical process industry. While the application of ozone to difficult oxidation problems is not new, Robert Van Tuyle, Emery's chemical director, revealed that in the ozonalysis of oleic acid, problems arose calling for the development of new and unusual techniques to make this process practical. Certain of these will be the subject of patents.

Production from this new plant will increase manyfold Emery's present output of azelaic and pelargonic acids, the two products which result from the oxidation of oleic acid and of which Emery is now the sole producer.

Oleic acid, the raw material for this new process, derived from animal fats and tallows, has been a basic product with Emery Industries for almost a century. Research, begun some twenty-five years ago and aimed at extending the use of this important fatty acid, first bore fruit in the development of the Emersol Process for separating fats into their various components. The higher degree of purity possible at a lower cost put oleic acid in a better competitive position.

Subsequently, some ten years ago Emery startled the chemical world with the discovery of a practical method of oxidation which would break down oleic acid into two new products which, up to that point, had been laboratory oddities. These interesting acids, azelaic and pelargonic, received almost immediate

*(Continued on Page 44)*

### Lubrication Guide Issued By Stewart-Warner Corp.

Specialized lubrication tools — those extension adapters, swivel adapters, suction guns, and so forth, which too often may be avoided by inexperienced lubrication men who are uncertain which to use under what circumstances — are simplified and explained in an illustrated "Selection Guide of Specialized Lubrication Tools" just issued by the catalog department of the Alemite division of Stewart-Warner Corporation.

A lubrication man, with the simple 14 by 11 inch guide at hand, has no excuse for not using the electromatic pully when lubricating a Packard, for instance, the nine-inch swivel adapter, Model 6278. Nor when servicing the wet clutch of a Hudson can he miss the information that a Model 7515-A suction gun is the proper tool.

Because the guide is set up in chart form, much like a mileage-between-cities chart, with the car make set up in the vertical column and the eight specialized tools strung out horizontally so that at the intersecting point the lubrication operation appears, it is practically impossible for the operator to select the wrong gun or accessory for any given operation.

In addition, a chassis drawing with arrows pointing to every item named—such as torque shaft, steering gear, control arms, rear springs, etc.,—appears alongside the chart.

In the same gate-page catalog sheet other specialized lubrication items such as an air-operated gear flusher, a wheel bearing lubricator, pistol oiler, spring oiler, air-operated oil spray, gooseneck nozzle, fitting replacement tools and other items are covered, as is a specialized gun rack for holding specialized guns, oilers and small accessories in a space occupying less than a square foot of floor space in a lubrication department.

The Alemite Specialized Lubrication Tools catalog sheet is Form No. 38-808, available through Alemite distributors and jobbers in all cities.

### Industrial Council Will Discuss Petroleum Industry This Month at Rensselaer Polytechnic Institute

The story of oil, with its transforming impact on world economy, will undergo searching scrutiny at Rensselaer Polytechnic Institute May 16 and 17 when The Industrial Council, recently formed at the institute, conducts its first assembly.

The petroleum industry has been selected as the subject for the council's first symposium, Dr. Ray Palmer Baker, council director said, because the economic world has come to realize that oil is one of the largest and most important parts in world economy.

"In that role," he declared, "it serves fittingly as an introduction to the work of this council which aspires to show the contribution of the corporation to society."

World leaders in the oil and other industries, selected science and social studies teachers, students and the general public will converge on the institute campus for the symposium.

Among leaders in the oil industry whom they will hear as the picture of the oil industry is examined, will be Joseph E. Pogue, petroleum consultant for the Chase National Bank; Sidney A. Swensrud, president of Gulf Oil Corporation; and Leonard F. McCollum, president of Continental Oil Company.

It is expected that the various meetings will have an invited attendance of at least 2000 persons. In addition, general sessions will be open to any interested persons.

Stressed throughout the two days will be industry's growing consciousness of its responsibility to the consumer as well as to the stockholder. Through interpretative addresses and panel discussions, the council hopes to emphasize the definite effect which large industry has on the life of every individual.

It will seek answers to the vexing problems of spiraling taxation, labor relations and the development of new markets and sources of supply.

## Emery Will Begin . . . . . . . .

*(Continued from Page 43)*

acceptance even though their prices were relatively high.

Now, because of the efficiency of the new "ozone" process, much larger volumes of these acids will be available and at considerably lower prices. In fact, with one possible exception, azelaic acid will be the cheapest higher molecular weight dibasic acid on the market today. Likewise, pelargonic acid will be the cheapest monobasic aliphatic acid of its type.

In addition to increased efficiency, other advantages for this new process are claimed by Emery. The corrosion problem, which has been one of the difficulties associated with chromic acid oxidation, has been eliminated. Higher yields of purer products follow. It is also predicted that the new unit will be more versatile, making possible a broader selection of raw materials which in turn will lead to a greater variety of end products, especially as other applications of this unique oxidation process are developed.

Production from the new plant may be expected within less than a year, certainly by the middle of 1953. Meanwhile, the pilot plant has been operating for many months, testing these new techniques while the final specifications for the new plant were being drawn to permit sampling of these products representing the higher quality resulting from this new process.

Not the least interest in this development stems from current investigations in the use of dibasic acids and their esters in synthetic lubricants both for military and civilian uses. In fact, there is a rather revealing article on this subject in the February issue of *The Institute Spokesman*, and grease manufacturers are devoting a great deal of attention to these developments. This new field may well consume a considerable portion of Emery's new capacity.

Meanwhile, the use of azelaic in the production of alkyd resins as well as in the manufacture of plasticizers for the vinyls, cellulosics, and synthetic rubbers, can be expected to expand as costs come down. Both of these uses have been proved during the years that Emery has operated its chromic-oxidation plant. Only the limited availability and relatively high price has restricted expansion in fields where it will be possible to obtain the excellent low-temperature performances of many of the esters of azelaic acid even in relatively low-cost plastic materials.

Emery's research indicates that azelaic acid will grow in interest as a raw material for polyamides of the nylon type where superior water resistance can be expected.

The same conditions prevail with respect to pelargonic acid which already enjoys several important uses. For example, with its increased availability at lower cost, the excellent efficiency of pelargonic in flotation can be extended where costs may have been a determent.

Another very interesting possibility is in the increased use of pelargonic acid in the field of perfumes and fine chemicals. Actually, the name "pelargonic" comes from a botanical term associated with geranium oil.

In this day of international turmoil it is well to note that azelaic acid is made from tallow or grease, domestic raw materials which currently, are available in surplus supply. On the other hand, its nearest chemical counterpart, sebacic acid, is derived from castor oil, an imported raw material.

In discussing this development with the Welsbach people, it was learned that this will be the world's largest single installation for the production of ozone. It marks another step in the interesting chemical developments possible through the utilization of this extremely active oxidizing material which by its very nature, eliminates many of the technical difficulties associated with the other methods of oxidation.

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## Precision Has Available "Secron" Second Stop-Clock

A dependable, low cost stop-clock, with the accuracy of a stopwatch but the across-the-room visibility of a household clock, is available for laboratory use. The "Secron" Timer has a 36-hour movement controlled by two buttons on top: green for start, red for stop. The reset knob is on the back. The clear black-on-white dial is marked in seconds, and a large sweep hand permits estimations to half a second. A smaller integrating hand registers total time elapsed up to 60 minutes. Case size is 4 by $4\frac{1}{2}$ inches.

### Witco Chemical Co. Prepares Technical Service Bulletin

A Technical Service Bulletin, G-3, describing the characteristics and uses of Witco Lithium Hydroxystearate has been published by the Witco Chemical Company. Chemically a lithium salt of 12-hydroxystearate acid, the new product is a metallic soap used as a gelling agent in the manufacture of synthetic and multi-purpose greases.

Greases prepared with this soap have excellent shear stability, high dropping points, low volatility, good anti-wear qualities and water resistance. The soap is of high purity and very low free fatty acid content which insures a grease of good oxidation stability.

Witco Lithium Hydroxystearate is a white powder of 99 per cent fineness through a 100 mesh, has a softening point of 205 degrees C. and a specific gravity of 1.0. It is packaged in 50-pound packages.

For copies of Technical Service Report G-3, write to Witco Chemical Company, 295 Madison Avenue, New York 17, New York.

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### Booklet on Power Farming Published by OIIC of API

How the American farmer overcame 20 centuries of stagnation in agriculture, to advance his status from "the man with the hoe" to the largest individual director of mechanical horsepower in our industrial age, receives a fresh and provocative telling in a 16-page booklet entitled "Power Farming—A Way of Life."

Liberally illustrated in golden harvest color, this booklet is published by the Oil Industry Information Committee of the American Petroleum Institute to foster understanding of the interdependance of agriculture, petroleum, and other industries in a free, competitive economy.

Copies are being distributed to agricultural leaders, editors, vocational agricultural teachers, USDA extension personnel, farm organizations, oil companies and allied industries. Single copies may be obtained gratis while agricultural departments may obtain up to ten free copies by requesting them through the national OIIC offices. Mul-

*(Continued on Page 47)*

**Booklet . . . . . . . . . . . . . .**

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tiple copies may be obtained at cost by oil companies and others, many of whom are expected to augment OIIC rural distribution.

An introductory profile reminds that the American farmer before the close of the 19th century became the first conqueror of famine in all history. It throws the towering dimensions of his feat into sharp relief with a description of his meagre heritage from Old World agricultures. Farm practices in colonial times stemmed with slight alteration from the early Roman Republic. The most notable exceptions — development of the horse collar, the tandem hitch and the horseshoe in feudal Europe of the late ninth or early tenth centuries— were utilized by the resourceful American farmer to carry mechanization to the limits of animal power and to create an abundance.

"Power Farming—A Way of Life" brings strong historical evidence to bear on the vital relationship, frequently overlooked, between technological and economic progress in agriculture and the growth of free democratic institutions. Individual initiative, private enterprise and other creative forces released by American political and economic freedoms are shown to have directly propelled the American farmer in his mechanization progress; they also forged rapid advances in industry, science and transportation essential to power farming development.

Petroleum enters the narrative midway in the first cycle of farm mechanization during the horse and kerosene age. Discovery of Drake's well in 1859 ushered in large-scale kerosene illumination, lengthening the farmer's day for social enjoyment. Supplanting the less stable animal fats and vegetable products, petroleum greases and lubricants in implements and wagons eased the friction loads on work animals. Similar service to locomotives helped speed the extension of railroad transportation throughout agricultural areas.

In its final section, entitled "Oil-Powered Farming", the booklet presents the story of farm motorization. Tracing the emergence of the commercial tractor industry, it describes the dramatic Winnipeg plowing contests that witnessed the triumph of internal combustion engines and petroleum power over steam during this century's first decade. Reported also are succeeding milestones of tractor development and petroleum utilization that bolster and sustain power farming as an abundant and secure way of life today.

Answering the question why earlier agricultures, rich in human and natural resources, failed to produce a fraction of the progress made by the American farmer in a few generations, "Power Farming—A Way of Life" concludes:

"The answer lies in America's unique climate of political and economic freedom. Here initiative and competitive enterprise, agriculture, industry, commerce, and science move forward hand in hand."

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## The Technical Committee

**Chairman T. G. Roehner**
**Director of the Technical Service Department**
**Socony-Vacuum Laboratories**

The January 1952 issue of *THE INSTITUTE SPOKESMAN* carried a paper entitled "Rheological Studies and Electron Microscopy of Calcium Stearate-Cetane Gels." More specifically, an account was given of the exploration of changes in structure in the system calcium stearate-cetane with water content and with mechanical working using electron microscopy of thin slices as a tool.

This work was conducted under the NLGI Research Fellowship held by Dr. R. D. Vold, of the Department of Chemistry and Electron Microscopy Laboratory, University of Southern California.

Dr. Vold reports that the same problem is now being studied by a new method for the detection and measurement of orientation of soap crystallites produced in grease samples by small shearing stresses. The orientation distribution of the crystallites is determined by means of x-ray diffraction.

It is hoped to find support and further means of development for the hypothesis that soap crystallites in a grease build a coherent superlattice of aggregated particles.

# FUTURE MEETINGS of The Industry

**MAY, 1952**

12-15 American Petroleum Institute (Division of Refining, 17th midyear meeting), St. Francis Hotel, San Francisco, Calif.

14-15 National Industrial Conference Board, Inc. (general session—all associates—36th annual meeting of board members), Waldorf-Astoria, New York, N. Y.

14-19 National Tank Truck Carriers, Inc. (4th midyear meeting), del Coronado Hotel, Coronado, Calif.

15-16 American Petroleum Institute (Division of Production, Pacific Coast district), The Biltmore Hotel, Los Angeles, Calif.

16 University of Kansas City (symposium on oil and gas), University of Kansas City, School of Law, Kansas City, Mo.

19-20 American Management Assn. (insurance), Hotel Statler, New York, N. Y.

19-20 American Petroleum Institute (Division of Marketing, midyear meeting), The Sheraton Plaza, Boston, Mass.

21-23 Oil Industry Information Committee, St. Francis Hotel, San Francisco, Calif.

27-28 American Petroleum Institute (Division of Marketing, Lubrication Committee), Mayo Hotel, Tulsa, Okla.

**JUNE, 1952**

1-6 Socy. of Automotive Engineers (summer meeting), Ambassador and Ritz-Carlton, Atlantic City, N. J.

5-6 Pennsylvania Grade Crude Oil Assn. (annual meeting), Hotel William Penn, Pittsburgh, Pa.

8-12 Canadian Gas Assn., Chateau Frontenac, Quebec City, Quebec, Canada.

9-10 Chemical Specialties Mfrs. Assn. (38th midyear meeting), Hotel Statler, Detroit, Mich.

9-13 National Fire Protection Assn. (annual meeting), Hotel Statler, New York, N. Y.

9-14 American Petroleum Institute (Division of Production, midyear standardization conference), Brown Palace Hotel, Denver, Colo.

19-20 American Management Assn. (general management), Waldorf-Astoria, New York, N. Y.

19-20 Kentucky Oil & Gas Assn., The Phoenix Hotel, Hotel Lafayette, Lexington, Ky.

22-25 Petroleum Equipment Suppliers Assn. (annual meeting), Mark Hopkins Hotel, San Francisco, Calif.

22-27 American Socy. for Testing Materials (Com. D-2 on Petroleum Products and Lubricants), New York, N. Y.

23-27 American Socy. for Testing Materials (annual meeting), Hotel Statler, New York, N. Y.

23-27 American Inst. of Electrical Engineers (summer general meeting), Nicollet Hotel, Minneapolis, Minn.

**AUGUST, 1952**

11-13 Socy. of Automotive Engineers (national West Coast meeting), Fairmont Hotel, San Francisco, Calif.

19-22 American Inst. of Electrical Engineers (Pacific general meeting), Westward Ho, Phoenix, Ariz.

**SEPTEMBER, 1952**

8-12 Instrument Society of America (7th nat'l instrument conference & exhibit), Cleveland Auditorium, Cleveland, Ohio.

9-11 Oil Industry Information Committee, The Traymore, Atlantic City, N. J.

9-11 Socy. of Automotive Engineers (national tractor meeting), Hotel Schroeder, Milwaukee, Wisc.

10 American Petroleum Institute (Division of Marketing, Lubrication Committee), The Traymore, Atlantic City, N. J.

10-12 National Petroleum Assn. (50th annual meeting), The Traymore, Atlantic City, N. J.

**SEPTEMBER, 1952**

14-19 American Chemical Society (122nd nat'l meeting) (Petroleum Division), The Traymore, Atlantic City, N. J.

22-24 American Trade Assn. Executives (annual meeting), Royal York Hotel, Toronto, Ontario

23-24 American Petroleum Institute (Executive Committee of the Board of Directors), Greenbrier, White Sulphur Springs, W. Va.

25-27 Independent Oil Compounders Association (5th annual meeting), Edgewater Beach Hotel, Chicago, Ill.

**OCTOBER, 1952**

1-4 (tentative) Socy. of Automotive Engineers (national aeronautic meeting and aircraft engineering display), New Hotel Statler, Los Angeles, Calif.

5-8 Controllers Inst. of America, Hotel Statler, Detroit, Mich.

6-8 National Assn. of Oil Equipment Jobbers (2nd annual meeting), The Neil House, Columbus, Ohio.

12-18 Oil Progress Week.

13-15 Texas Mid-Continent Oil & Gas Assn. (33rd annual meeting), Hotel Texas, Fort Worth, Texas

20-22 American Oil Chemists' Socy. (fall meeting), Netherlands Plaza Hotel, Cincinnati, Ohio.

20-24 National Safety Council (40th national safety congress and exposition), Conrad Hilton Hotel, Chicago, Ill.

22-24 Socy. of Automotive Engineers (national transportation meeting), Hotel William Penn, Pittsburgh, Pa.

27-29 National Lubricating Grease Institute (20th annual meeting), Edgewater Beach Hotel, Chicago, Ill.

29 Oil Trades Assn. of New York, Inc., Waldorf-Astoria, New York, N. Y.

**NOVEMBER, 1952**

3-4 Socy. of Automotive Engineers (national diesel engine meeting), Chase Hotel (tentative), St. Louis, Mo.

6-7 Socy. of Automotive Engineers (national fuels and lubricants meeting), Mayo Hotel, Tulsa, Okla.

8-13 Oil Industry Information Committee, Conrad Hilton Hotel, Chicago, Ill.

11-12 American Petroleum Institute (Board of Directors meeting), Conrad Hilton Hotel, Chicago, Ill.

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